Pandora MPEG-TS / HbbTV Analyzer User Guide

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1 Features

1.1 Introduction

Pandora Analyzer enables decoding for TS-188 bitstreams. This software is built by Vizion'R SAS and works with any computer with a working Java Virtual Machine (version 6+), it works better with computers with at least 2G of memory (RAM) and is tested with the following operating systems:

- Windows (XP, Vista, 7) (32/64 bits)
- Mac OS X (Snow Leopard or later) (32/64 bits)
- Linux / Unix (32/64 bits)

Pandora can be freely downloaded from Vizion'R website: http://vizionr.fr

1.2 Pandora Headless

Another version of the Analyzer exists, it is called Pandora Headless and can perform live reporting on MPEG2-TS / HbbTV Analyzer. It features:

- SNMP alerts
- a very flexible log system to trigger alerts/logs on specific conditions
- a very efficient report systems for creating logs about MPEG2-TS / HbbTV

Contact Vizion'R for further details.

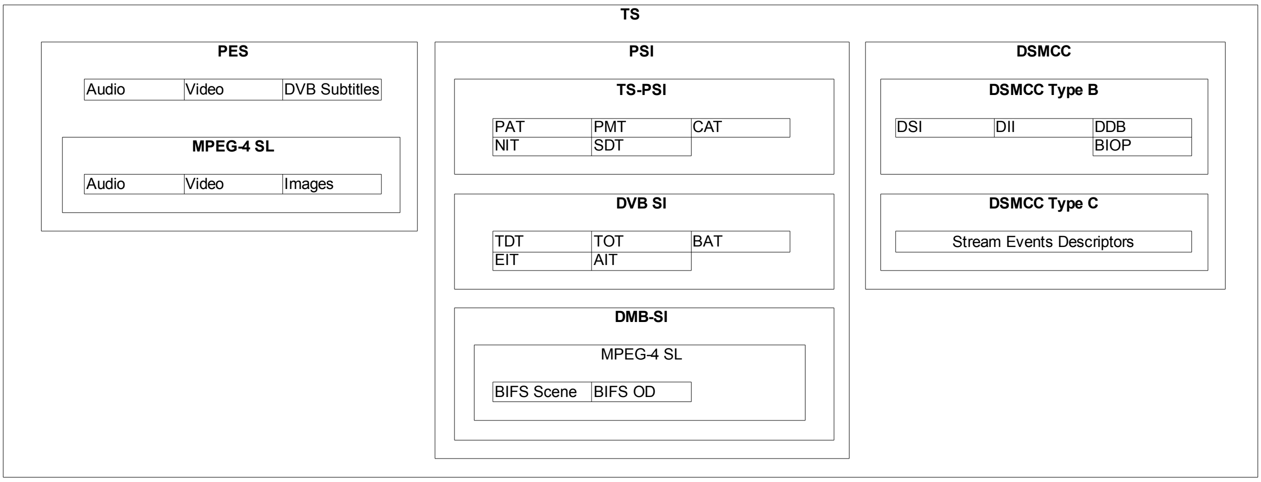
1.3 Supported Formats

TS streams can be accessed in different ways, listed below:

- Local TS files.
- UDP: raw TS packets sent in unicast/multicast mode, aligned or not on UDP payloads.
- Remote TS files/streams: read from HTTP/Icecast/Shoutcast server.
- Apple HLS (Http Live Streaming): m3u8 playlist files, MPEG-TS data format only.
- DVB cards: on Linux, Full Support for DVB Cards, Windows support for BDA Drivers exists but not present in default distribution. (Contact us if you need it).
- Dektec cards: for Linux and Windows (contact us)

2 Pandora decoding stack

Illustration 1: Pandora decoding stack



The illustration below (Illustration 1) synthesizes the decoding stack for the Pandora TS analyzer.

Here are the references for the different layer items in this document:

2.1.1 TS layer

The Transport Stream layer that encapsulates all other streams.

- See Features for the input formats supported by Pandora.
- See Connect to a TS stream for the input connection configuration.
- See Program elementary streams for the description of elementary PIDs in a program.
- See Elementary streams packets for the deep TS headers analysis view.
- See Elementary streams bitrates for bitrate analysis for stream PIDs.
- See Program clocks for TS layer timestamps decoding.
- See Dumping options for TS re-streaming.
- See Packets Sequence check for TS continuity counters check.
- See Stuffing analysis for TS stuffing analysis.

2.1.2 PES layer

Encapsulates elementary sub-streams into distinct entities. Those streams have a clock and are continually updated.

- See Elementary streams packets for deep PES headers analysis view.
- See Elementary streams bitrates for bitrate analysis for audio/video streams.
- See Program clocks for PES layer timestamps decoding.
- See Video snapshots for video I-Frames snapshot view.
- See Video subtitles for subtitles decoding and display.
- See Stuffing analysis for PES stuffing and encapsulation overhead analysis.

- See DMB analysis for DMB elementary streams data decoding and display.

2.1.3 PSI layer

Program Specific Information is a section of data : the data contained into those elements has some version that may be updated periodically. Example: Electronic Program Guide.

TS-PSI layer

- See Elementary streams packets for deep sections headers analysis view.
- See Elementary streams bitrates for bitrate analysis for sections data.
- See Data repetition rate for sections repeat rate analysis.
- See Stuffing analysis for Sections stuffing analysis.
- See Program Description overview for program description (Service Description Table).

DVB-SI layer

- See Electronic Program Guide for EPG decoding and display (EIT p/f, EIT schedule).
- See HbbTV Applications Data for Application Information Table decoding.
- See Program clocks for TDT/TOT clocks decoding.

DMB-SI layer

- See DMB analysis for DMB sections data decoding and display.

2.1.4 DSMCC layer

Handles all DSCMCC, this is where HbbTV Content is decoded.

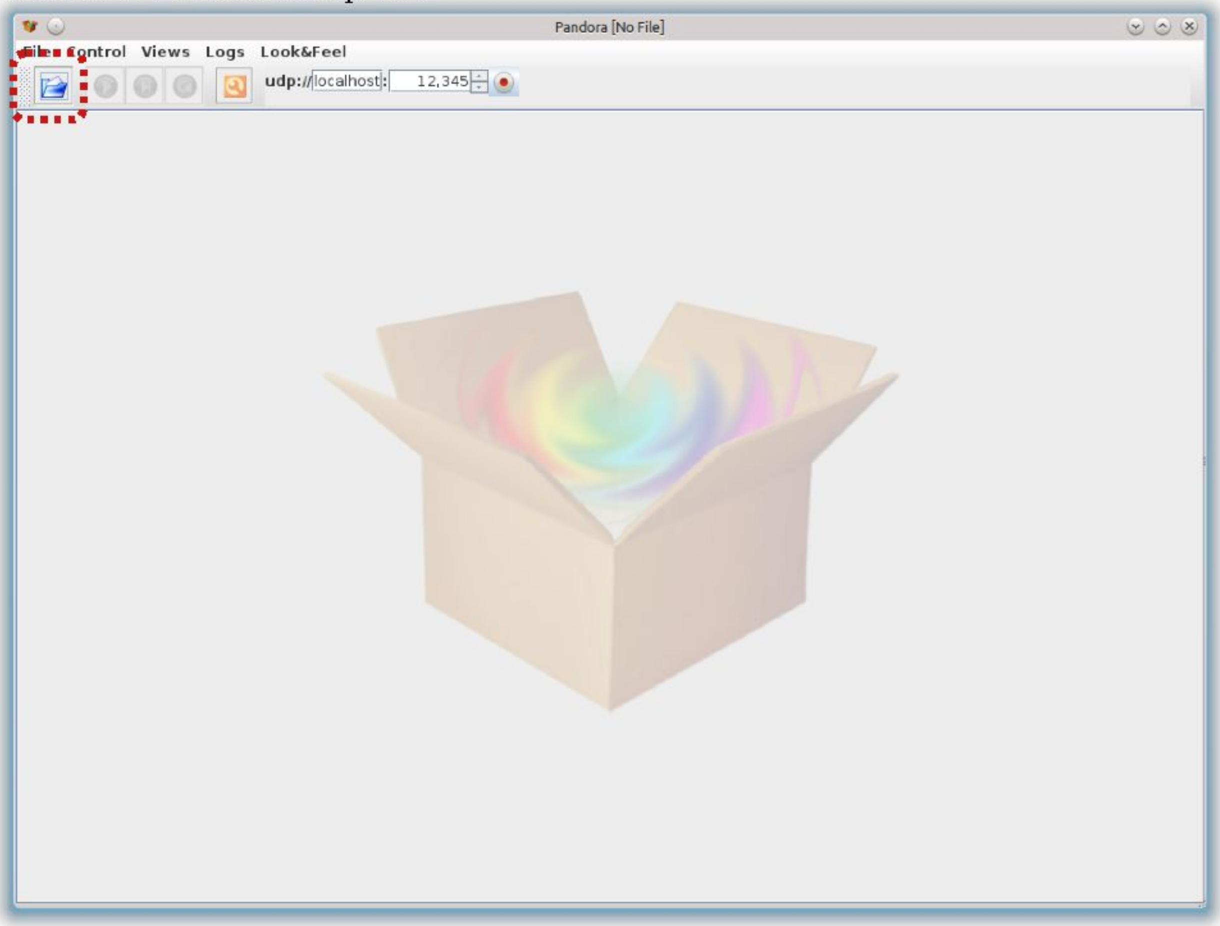
- See Elementary streams packets for the deep DSMCC Sections and modules headers analysis view.
- See HbbTV Applications Data for full HbbTV data decoding (Broadband signaling, Broadcast Object Carousels, Stream Events declaration and triggers).

3 Getting started

3.1 Connect to a TS stream

Once Pandora started, click on the "open" icon (or File > Load TS stream...) (Illustration 2).

Illustration 2: Pandora startup view

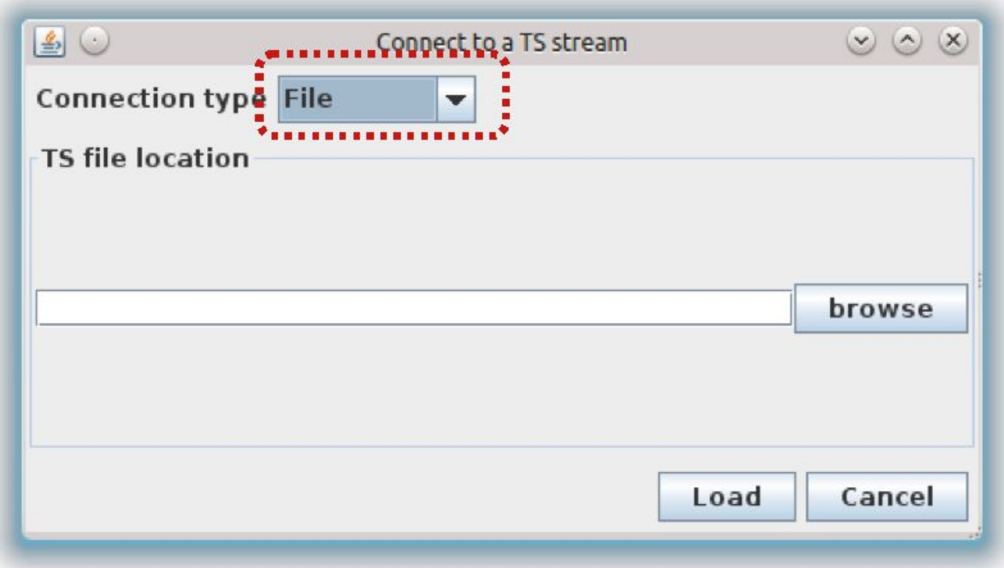


A dialog box will allow the configuration of the connection to a TS stream. All the supported formats are listed in a "Connection type" box.

3.1.1 Connection to a local TS file

To connect to a local TS file, select the "File" option in the "connection type" box (Illustration 3). Then, the TS file to be opened can be either typed in the blank text field (full path of the TS file), or selected by browsing the file system ("browse button"). The "Load" button triggers the connection (or "cancel" to abort).

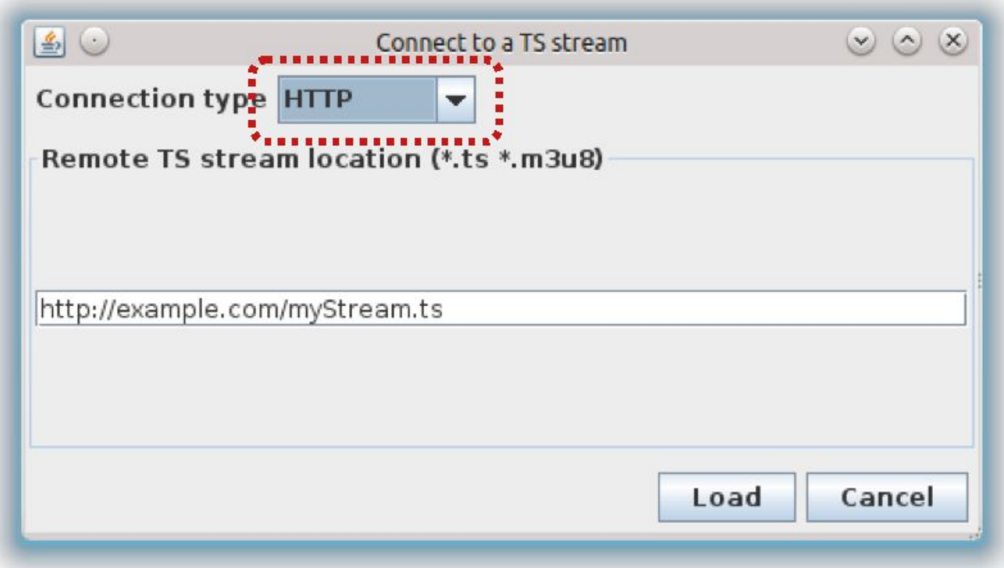
Illustration 3: Local TS file input configuration



3.1.2 Connection to remote TS contents

Remote TS data (remote TS files and streams, HLS playlists, see the supported formats) connection configuration can be performed by selecting the "HTTP" option in the "connection type" box (Illustration 4). The http:// URL of the TS resource can then be typed in the dedicated blank field. The "Load" button triggers the connection (or "cancel" to abort).

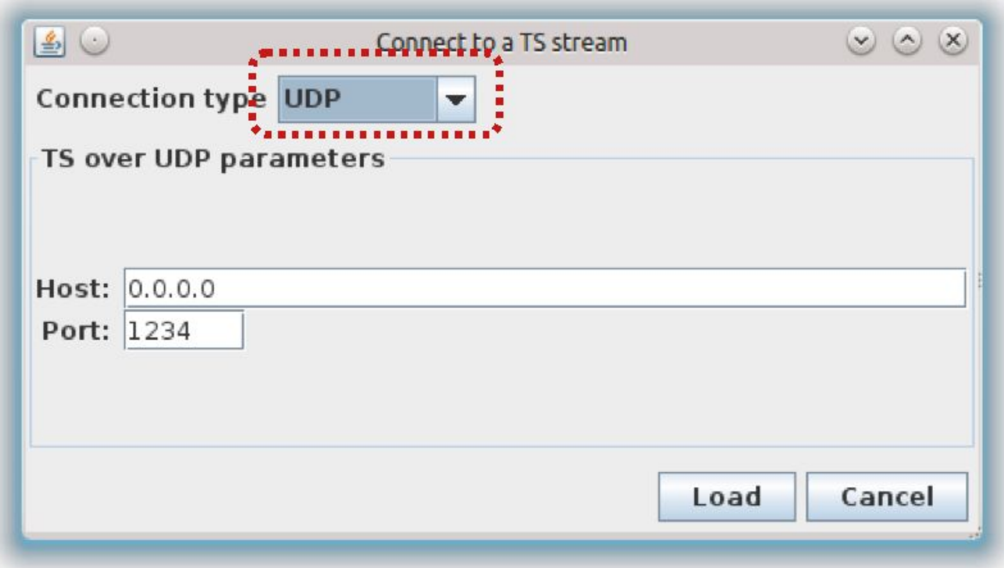
Illustration 4: HTTP input configuration



3.1.3 Connection in UDP mode

TS over UDP (unicast/multicast) data connection can be configured by selected the "UDP" option in the "connection type" box (Illustration 5). Then the UDP host and port must be set in the dedicated fields. For instance, if a multicast TS stream can be accessed from udp://239.1.2.3:12345, the "Host" field must hold the value 239.1.2.3, and the "Port" field has the value 12345. The "Load" button triggers the connection (or "cancel" to abort).

Illustration 5: UDP input configuration



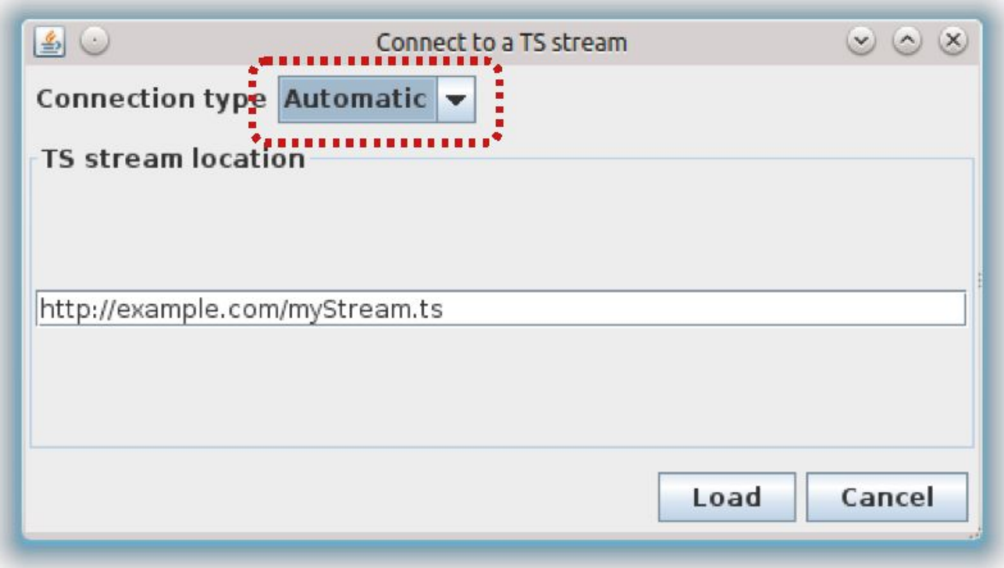
3.1.4 Connection in auto-detection mode

When the "Automatic" mode is selected in the "connection type" box, any URL for a supported format can be typed (Illustration 6). Pandora will then try to detect automatically the connection type. Examples of supported URL formats are listed below:

- Local files : /home/someuser/mpegts/myTsFile.ts, C:/Windows/user/Desktop/dump.ts
- TS over UDP : udp://localhost:1234, udp://127.0.0.1:2345, udp://224.1.3.2:10000
- Remote TS files : http://anywebsiteurl/randomTsFile.ts
- TS streaming : http://streamingserver:8000/tvChannel.ts
- Apple HLS : http://anotherstreamingserver/playlists/channelPlaylist.m3u8

The "Load" button triggers the connection (or "cancel" to abort).

Illustration 6: Automatic stream type detection



3.2 Launch Analysis

When a connection to TS data (see Connect to a TS stream), Pandora is ready to start decoding the TS stream. The decoding process can be controlled through a toolbar (Illustration 7) with the following enabled actions:

- Play / Pause: starts and pauses the decoding process. Be aware that the “pause” action can lead to data loss when TS data is accessed in a streaming way. The decoding processed shall only be paused when reading a static (local or remote) TS file. Pandora can also be configured to pause automatically on several decoding events (e.g. new data received on a target elementary stream, decoding error, see Pause triggering on decoding events)
- Step: Read a single packet then pause.
- Reload: performs a re-connection to the current TS stream (all data currently stored and displayed by Pandora will be cleared).



Illustration 7: Decoding controls toolbar

4 Pandora Analysis views

The Pandora analyzer displays several kinds of TS data analysis results spread on multiple views:

- Main view (mosaic): An overall description of the TS stream is synthesized in a mosaic view (see Programs Mosaic). This panel enables to get a quick snapshot of the TS stream composition (programs and associated services).
- Program view: For each program found in the TS stream, a dedicated view (see Program view) displays decoded data at two levels :
  - Applicative level: Display of application data for the services declared by the program (EPG, Subtitles, HbbTV, etc.).
  - Data packets introspection level: For every packet decoded on any layer of the analysis process (TS, PES/PSI, and deeper...), a dedicated view displays all the decoded frames headers. A tree view allows to perform precise error checks and streams validation.

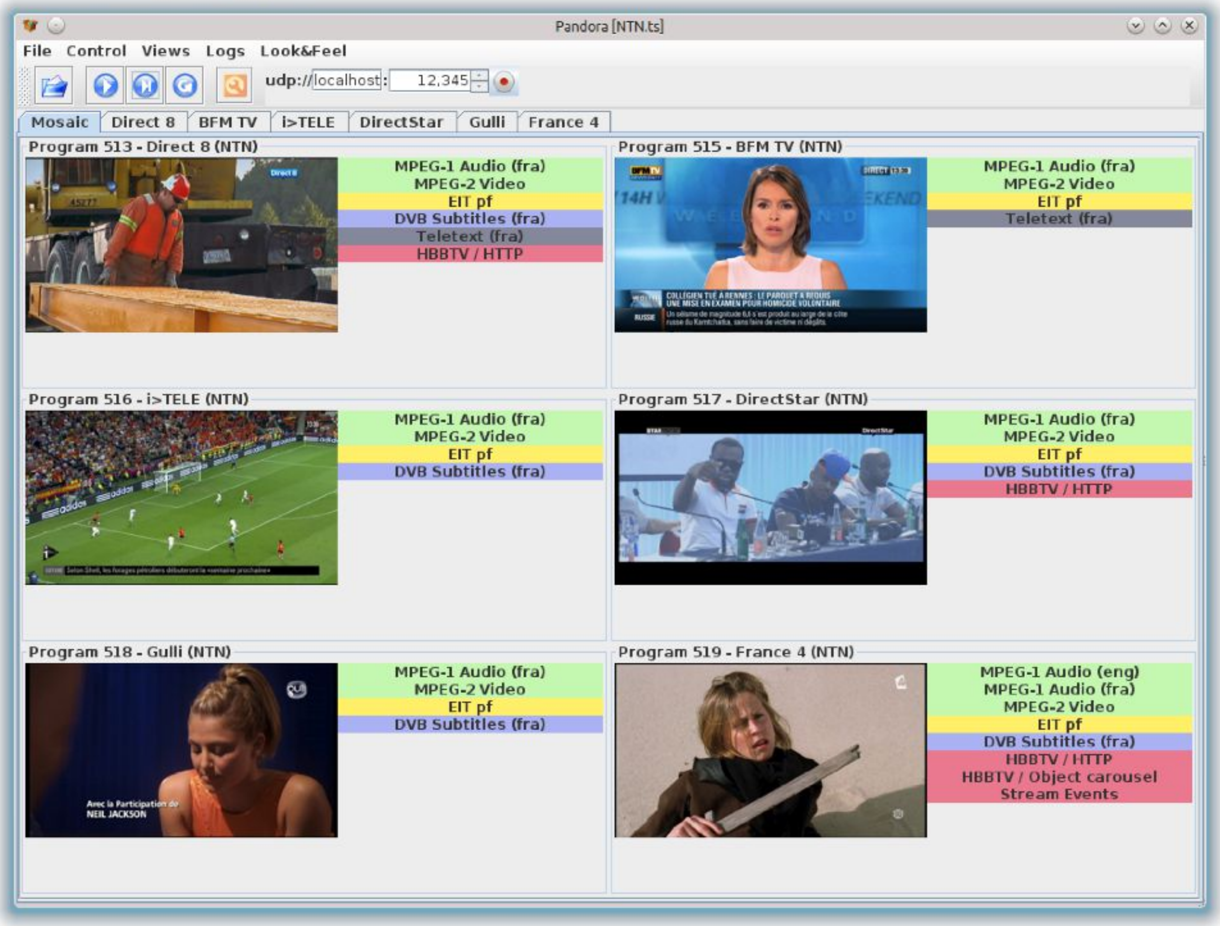
4.1 Programs Mosaic

The first view tab displayed by Pandora, called “Mosaic”, offers an overview of the TS stream contents (Illustration 8). For each program found in the stream, a widget is added to the mosaic. Those widgets give a quick overview of the associated program:

- Small snapshots of video I-frames (~ 1 second refresh cycle). Notice that the video will not show up in two cases:
  - The program does not declare a video stream: in this case, a “no video” icon  will be displayed instead.
  - The video stream is scrambled (program with conditional access): then a “lock” icon  will be displayed.
- Service items: all recognized services (DVB/HbbTV/DMB) for the program are listed as colored items. This way, the mosaic view allows to get a fast acknowledgment of the kind of application data that can be found for any present program.

For any program shown by the mosaic view, a dedicated panel displays more decoding information, as described in the next section.

Illustration 8: Mosaic view



4.2 Program view

View access : Select a channel in the main tab panel. The first tab is always the "Mosaic" view. When no program has been yet found in the input stream, an "Initialization" view is present instead.

Pandora offers a dedicated view for each program found in the input TS stream. This view allows examination of the program data in several modes:

- Low level examination: full decoding of packets headers for all decoding layers (TS, PES/PSI, DVB/HbbTV/DMB services).
- Data transport analysis level: bitrate, repetition rates, clocks and, stuffing and so on.
- Application level examination: high level presentation of service data (Video snapshots, DVB subtitles, EPG, etc.)

4.2.1 Program elementary streams

<u>View access</u> : Select a channel in the main tab panel, then select the "Channels" tab in the leftmost panel.

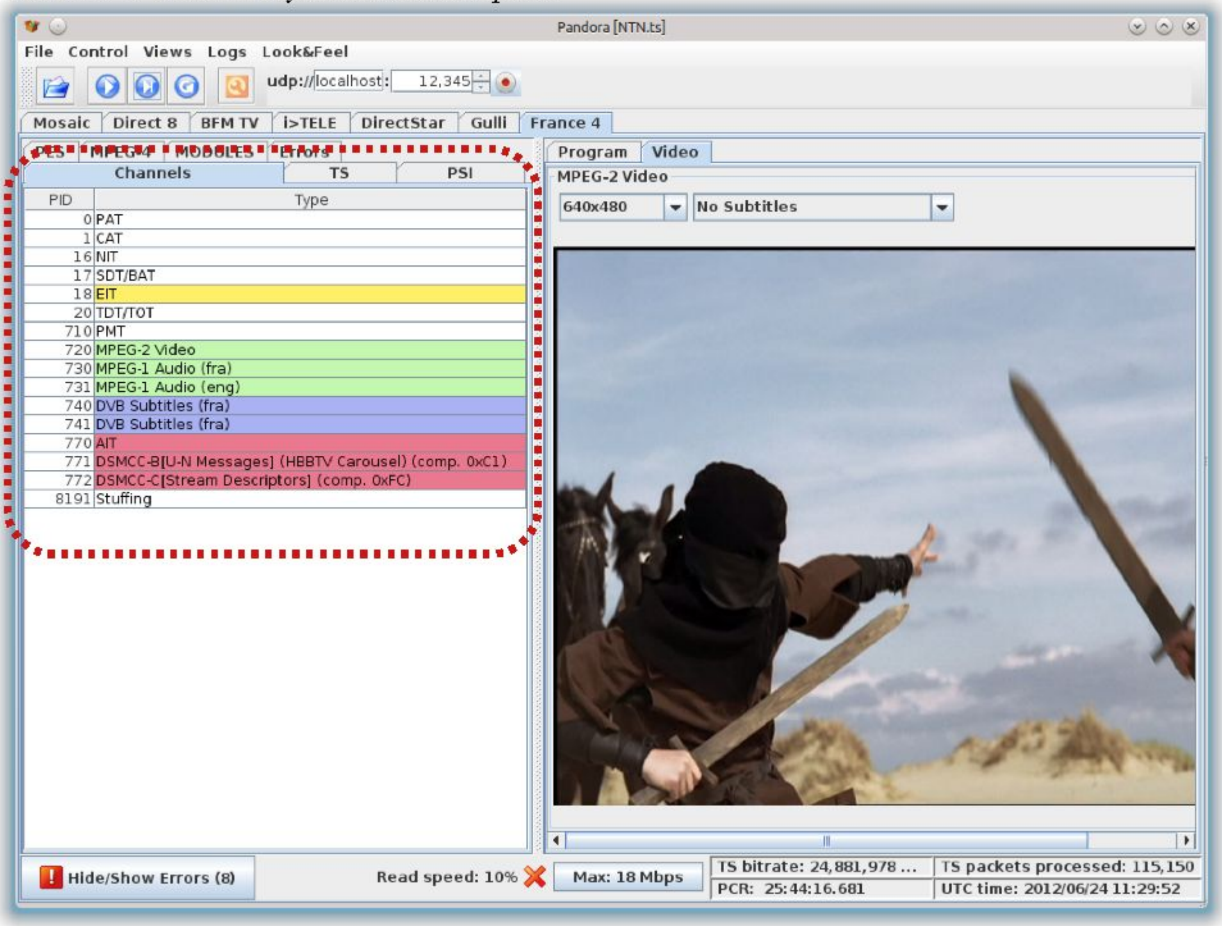
For a given program found in the input TS stream, all elementary streams attached to the program are listed in a table (<u>Illustration 9</u>) , in the following format :

- PID of the elementary stream.
- Human-readable label for the stream. Some elementary streams carrying well-known services data are colored. Those colors match the corresponding stream description in the mosaic view for the program (see <u>Programs Mosaic</u>).

The listed PIDs are those within the scope of the program, that is :

- The PIDs of the streams declared in the Program Map Table (PMT) for the program.
- The cross-programs PIDs (PAT / SDT / EIT / TDT and so on...), provided those PIDs are actually found in the input stream.
- Therefore, PIDs associated with other programs will not appear in the list (if not cross-program).

Illustration 9: Elementary streams description



4.2.2 Elementary streams packets

View access : Select a channel in the main tab panel, then select one of the layer items tab (TS/PSI/PES/etc.) in the leftmost panel.

For expert debugging/validation purposes, Pandora allows to browse packets header at any layer of the decoding stack. Every frame header is deeply analyzed and all the frame elementary fields are presented in a tree (Illustration 7), following this format:

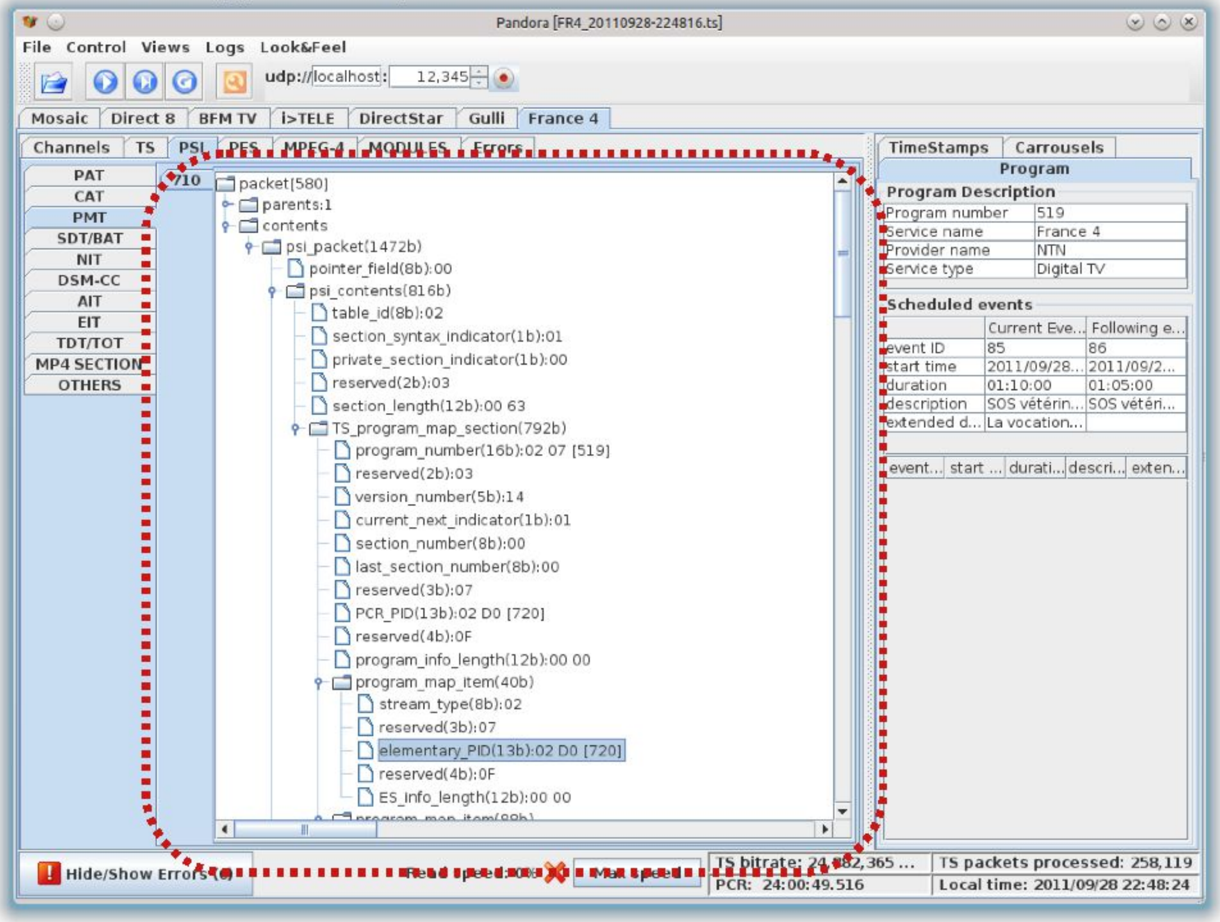
- The root of the tree is the packet entry itself, along with a packet number attributed by the layer decoder, incremented by one for each new decoded packet for the same layer.
- The root node declares two child nodes:
  - The "parents" node gives a recursive description of all the parents packets whose aggregated payload led to this packet.
  - The "contents" node gives a full decoded description of the current packet header. Each decoded field is printed as a child node in the following format:
    - Name of the field: usually matches the corresponding entry in the associated standard.
    - Length of the field: in bits.
    - Raw value of the field: in hexadecimal format.
    - Pretty value for some well-known fields: PIDs, strings, etc.

All the analyzed packets trees are stored in separate tabs, organized in semantic items:

- TS layer packets are stored in the "TS" tab.
- MPEG sections are stored in the "PSI" tab. This tab is split into well-known section entries:
  - Program Association Sections are stored in the "PAT" tab.
  - Conditional Access Sections are stored in the "CAT" tab.
  - Program Map Sections are stored in the "PMT" tab.
  - Service Description Sections and Bouquet Association sections are stored in the "SDT/BAT" tab.
  - Network Information Sections are stored in the "NIT" tab.
  - DSMCC sections are stored in the "DSM-CC" tab.
  - Application Information Sections are stored in the "AIT" tab.
  - Event Information Sections are stored in the "AIT" tab.
  - Time and Date Sections and Time Offset Sections are stored in the "AIT" tab.
  - MPEG-4 Sections are stored in the "MP4 SECTIONS" tab.
  - Every other sections are stored in the "OTHERS" tab.
- Audio, video and all other Program Elementary Stream data is stored in the "PES" tab.
- MPEG-4 sections (DMB, see DMB analysis) are stored in the "MPEG-4" tab.
- DSMCC modules (HbbTV, see HbbTV Applications Data) are stored in the "MODULES" tab.
- Packets with errors (see Decoding Errors) are stored in the "ERRORS" tab.

- For every present logical item tab, one packet tree exists for a given PID (corresponding to the last decoded packet for this PID).

Illustration 10: Deep packets analysis



4.2.3 Program Description overview

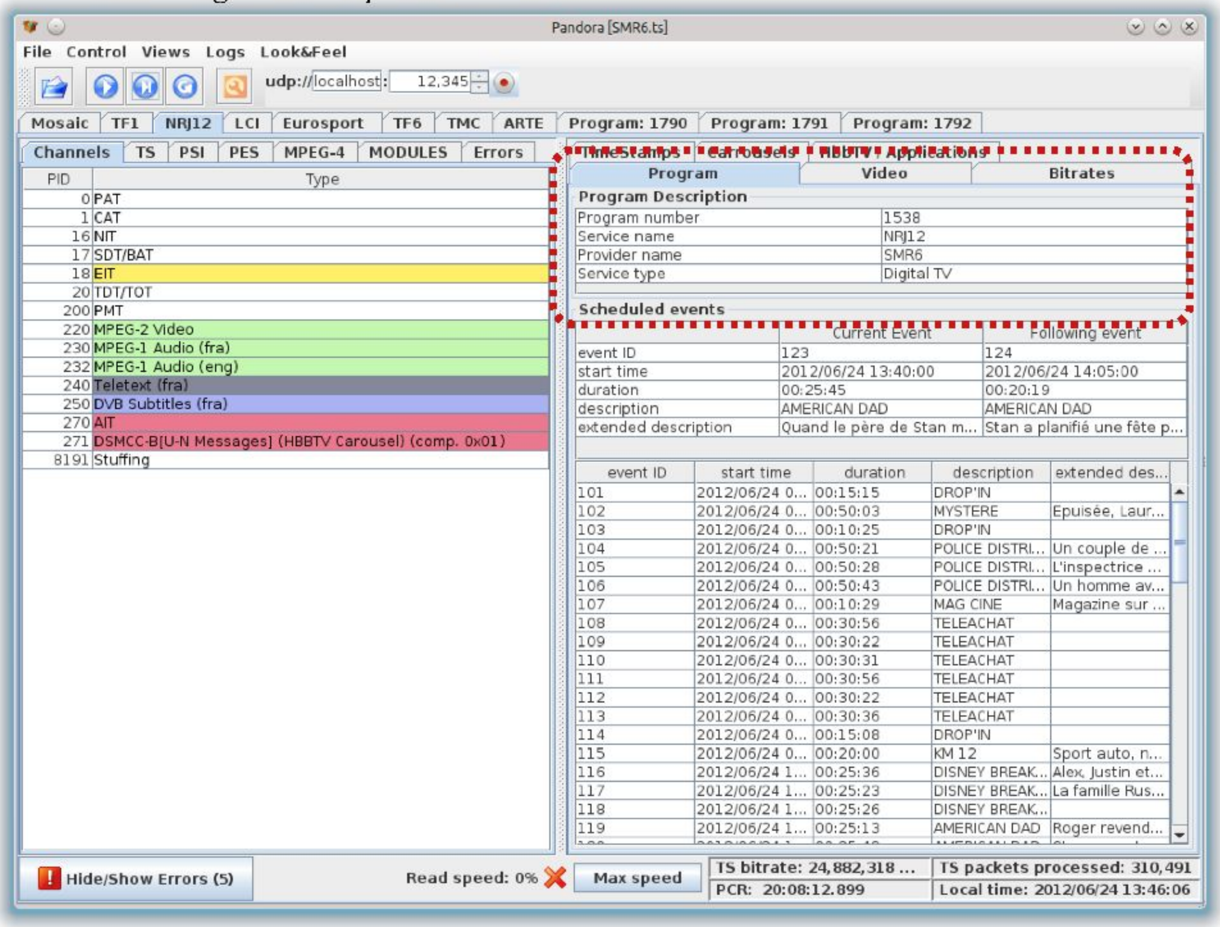
View access : Select a channel in the main tab panel, then select the "Program" tab in the right panel. If the "Program" tab is not present, use the menu bar: Views>Program. The program description is the upmost panel of the Program view.

The program view (Illustration 11) shows a short description of a program:

- Program Number: as found in the primary Program Association Table (PAT) that declares the program.
- Service name, provider name and service type: as found in the Service Description Table (SDT), if provided. Otherwise those files remain empty.

The program view also presents EPG data for the program, see Electronic Program Guide.

Illustration 11: Program description overview



4.2.4 Electronic Program Guide

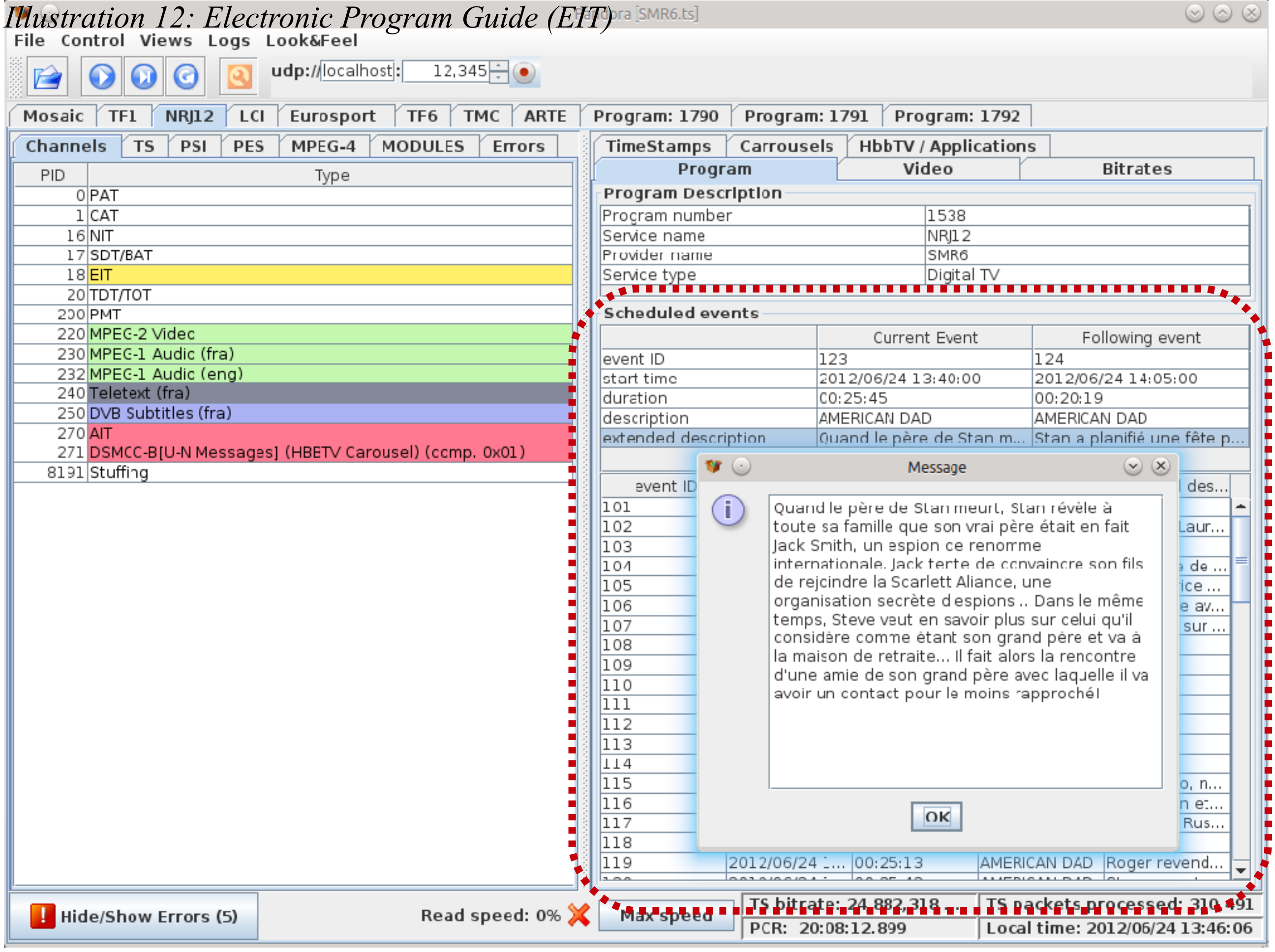
View access : Select a channel in the main tab panel, then select the "Program" tab in the right panel. If the "Program" tab is not present, use the menu bar: Views>Program. The EPG description panel is titled "Scheduled events".

Pandora fully decodes DVB EPG data for a given program:

- Present/following events data: as found in Event Information Sections (p/f type, actual TS). The upmost panel in the "Scheduled events" panel displays a description of the current/following events for the program (Illustration 12):
  - ID of the event.
  - Start time and duration.
  - Short and extended descriptions.
- Scheduled events data: as found in Event Information Sections (schedule type, actual TS). All scheduled events in a 2-days wide window are stored in a schedule table. Each event item exposes the same fields as the EIT p/f items.

Every table cell item can be clicked in order to access the full description of the field in a separate dialog box (Illustration 12). Notice that Pandora does not provide display of EPG data for other Transport Streams (EIT p/f other TS, EIT schedule other TS). Nevertheless, the associated sections data can be inspected at low level through the packets headers view (see Elementary streams packets).

Illustration 12: Electronic Program Guide (EIT)



4.2.5 Video snapshots

View access : Select a channel in the main tab panel, then select the "Video" tab in the right panel. If the "Video" tab is not present, use the menu bar: Views>Video.

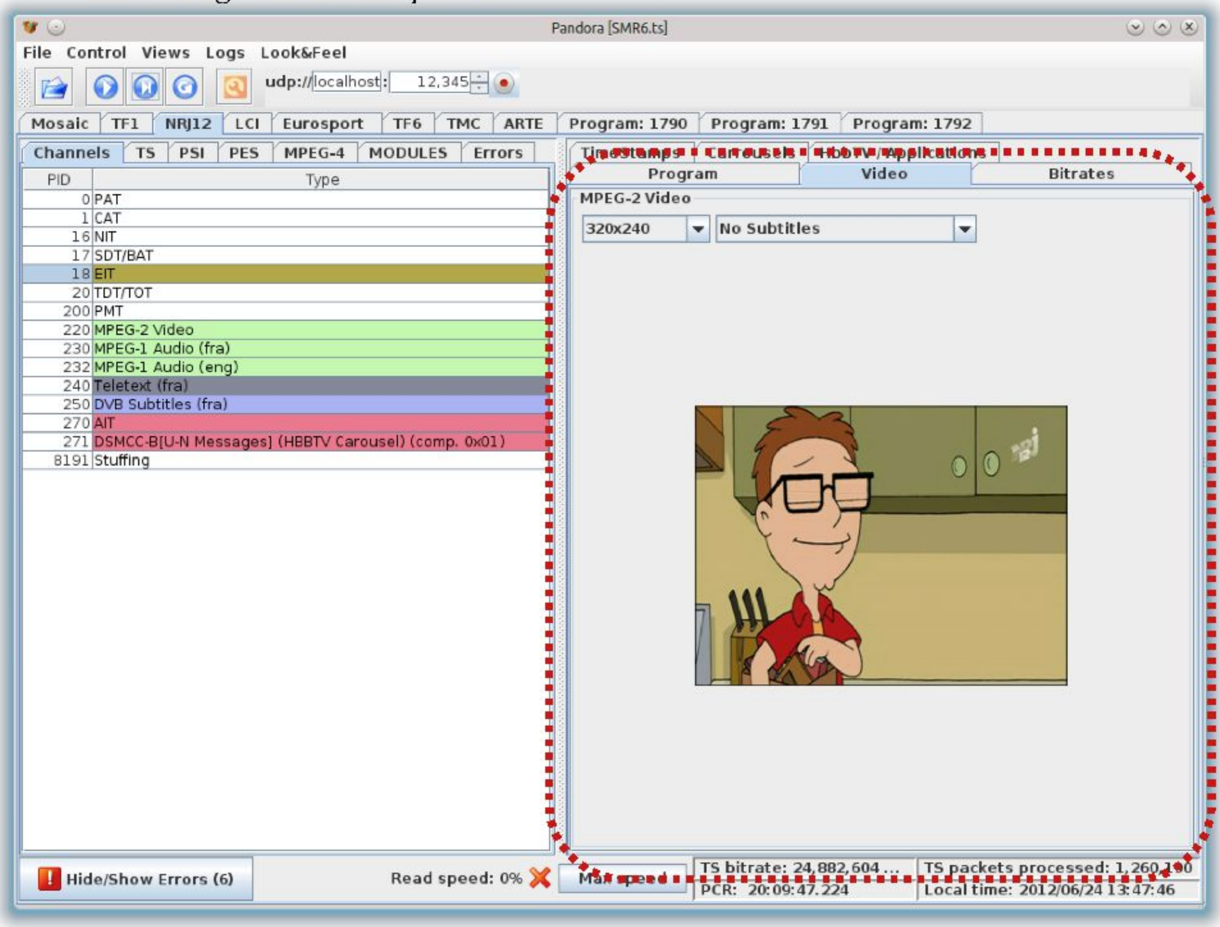
The Video view displays pictures snapshots (Illustration 13) of the program video stream (if any). Snaphosts are generated from video I-Frames (intra coded pictures) for the following supported formats:

- MPEG-2 video streams.
- H264 video streams.

Default behavior is to render the picture at the original size of the video component. But in order to ease visualization on low resolution screens, a list box allows to change the size of the rendered picture (be aware that video aspect ration can then be modified). The video snapshots are refreshed every second.

If the program declares one or more DVB subtitles for the video component, the subtitles can be overlaid on the video picture (with respect to th current rendering aspect ratio). See Video subtitles.

Illustration 13: Program video snapshot



Notice that Pandora uses ffmpeg to generate pictures from the I-Frames payloads. If the ffmpeg executable is not found, Pandora will suggest to download a ffmpeg version for the target system architecture, and will automatically install it.

4.2.6 Video subtitles

<u>View access</u> : Select a channel in the main tab panel, then select the "Video" tab in the right panel. If the "Video" tab is not present, use the menu bar: Views>Video. If DVB subtitles are present for the channel, a list box allows to select one of them. Once selected, subtitles will be drawn in overlay of the video snapshots. To get a listing of past decoded subtitles, select the "DVB Subtitles" view in the right panel. If the tab is not present, use the menu bar: Views>DVB Subtitles.

The Pandora analyzer provides decoding and rendering of subtitles with the following restrictions:

- DVB subtitles only. There is no support for Teletext subtitles yet.
- Picture-coded subtitles only. There is no support for Text-coded subtitles yet.

DVB subtitles can be accessed in two modes:

- Video overlay mode (<u>Illustration 14</u>): The Video view (see <u>Video snapshots</u>) allows to draw subtitles on the video snapshots. Several subtitles streams are available (for different languages) can be associated with a single video stream. The subtitle data to be drawn can be chosen in a list box on top of the video panel.
- Subtitles capture mode (<u>Illustration 15</u>): A dedicated view provides a windowed capture (15 items max.) of incoming subtitle frames. For each newly decoded subtitling frame, the corresponding subtitle picture is stored in a tab, indexed with the timestamp received for the frame.

Illustration 14: DVB subtitles analysis - subtitles on video

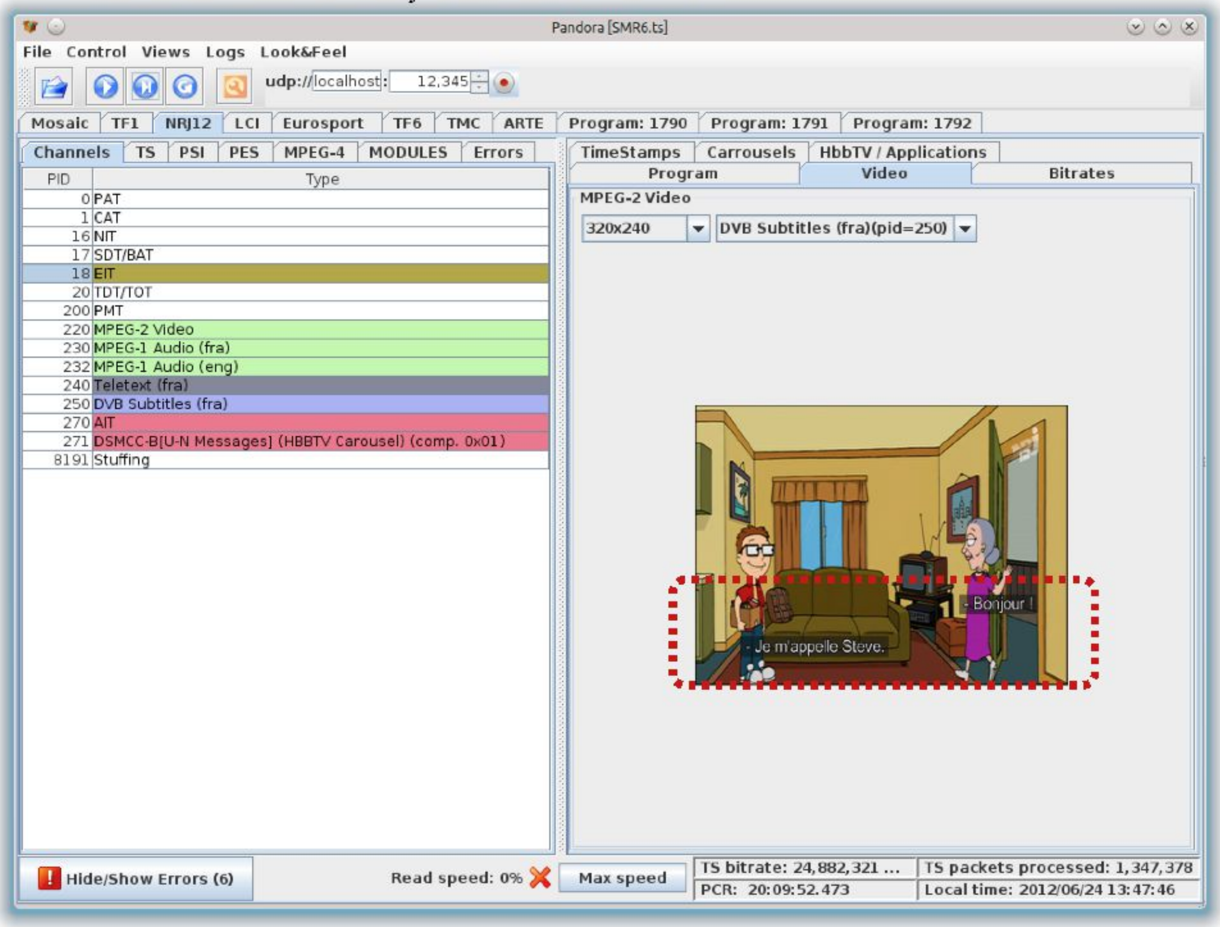
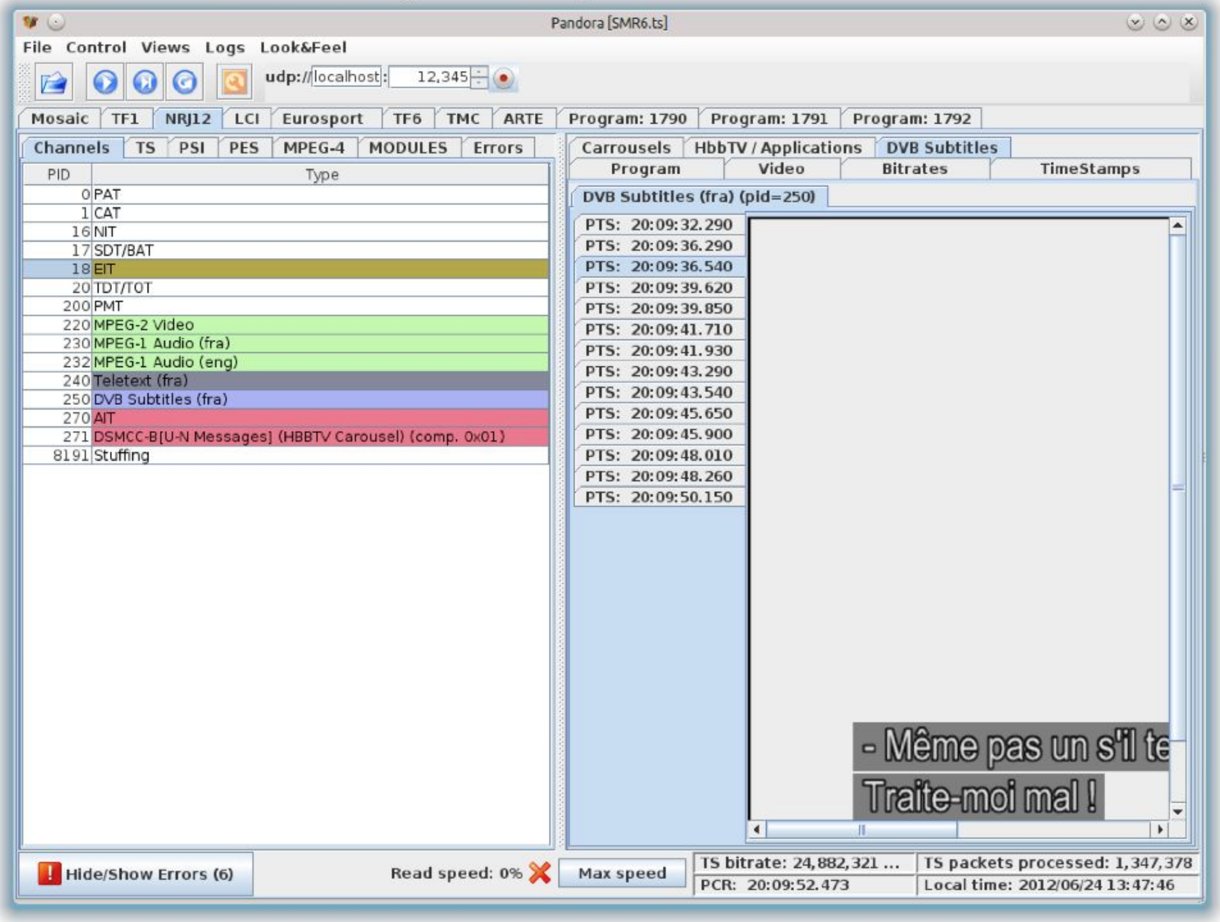


Illustration 15: DVB subtitles analysis - subtitle frames



Elementary streams bitrates

View access : Select a channel in the main tab panel, then select the "Bitrates" tab in the right panel. If the "Bitrates" tab is not present, use the menu bar: Views>Bitrates .

For each elementary stream associated with the program, Pandora computes a framed bitrate analysis and results are displayed in a pie chart with two possible modes:

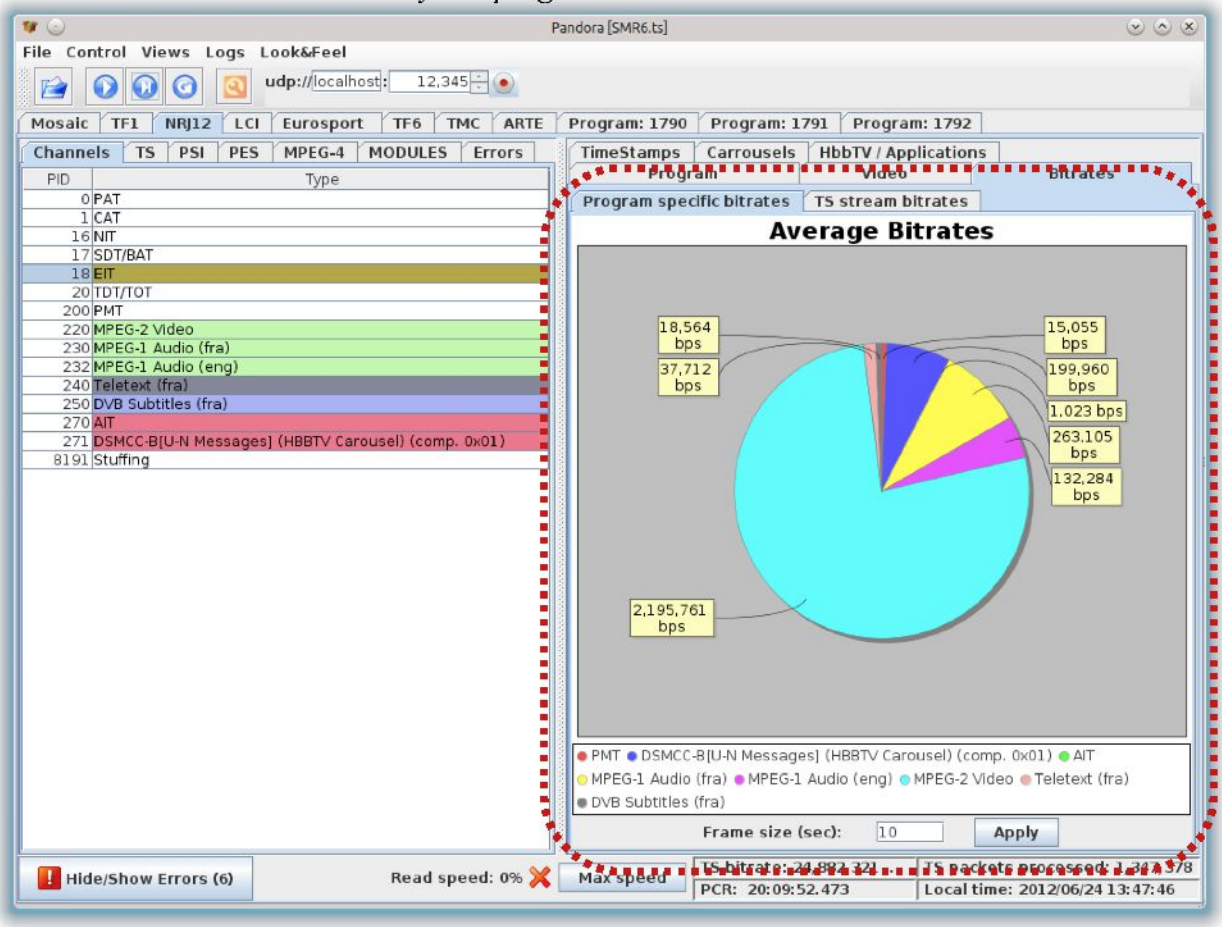
- Program-streams-only mode (Illustration 16): The pie chart gathers bitrates for all elementary streams within the scope of the program.
- Program-within-TS mode (Illustration 17): The pie chart adds to the preceding chart the bitrate amount for all other elementary streams in the whole TS stream. This chart can then give an overview of the program bitrate weight into the full TS stream.

Notice that the bitrates are computed:

- According to the program clock (Program Clock Reference, see Program clocks). The system clock (of the machine that is running Pandora) is not used. Thus bitrate analysis can be performed precisely on "static" TS files. If the program does not declare a clock stream (the one that holds PCR timestamps), no bitrate analysis will be performed for the program.
- On a frame period: default is 10 seconds, but the frame size can be adjusted (in seconds) with the configuration box below the pie chart.

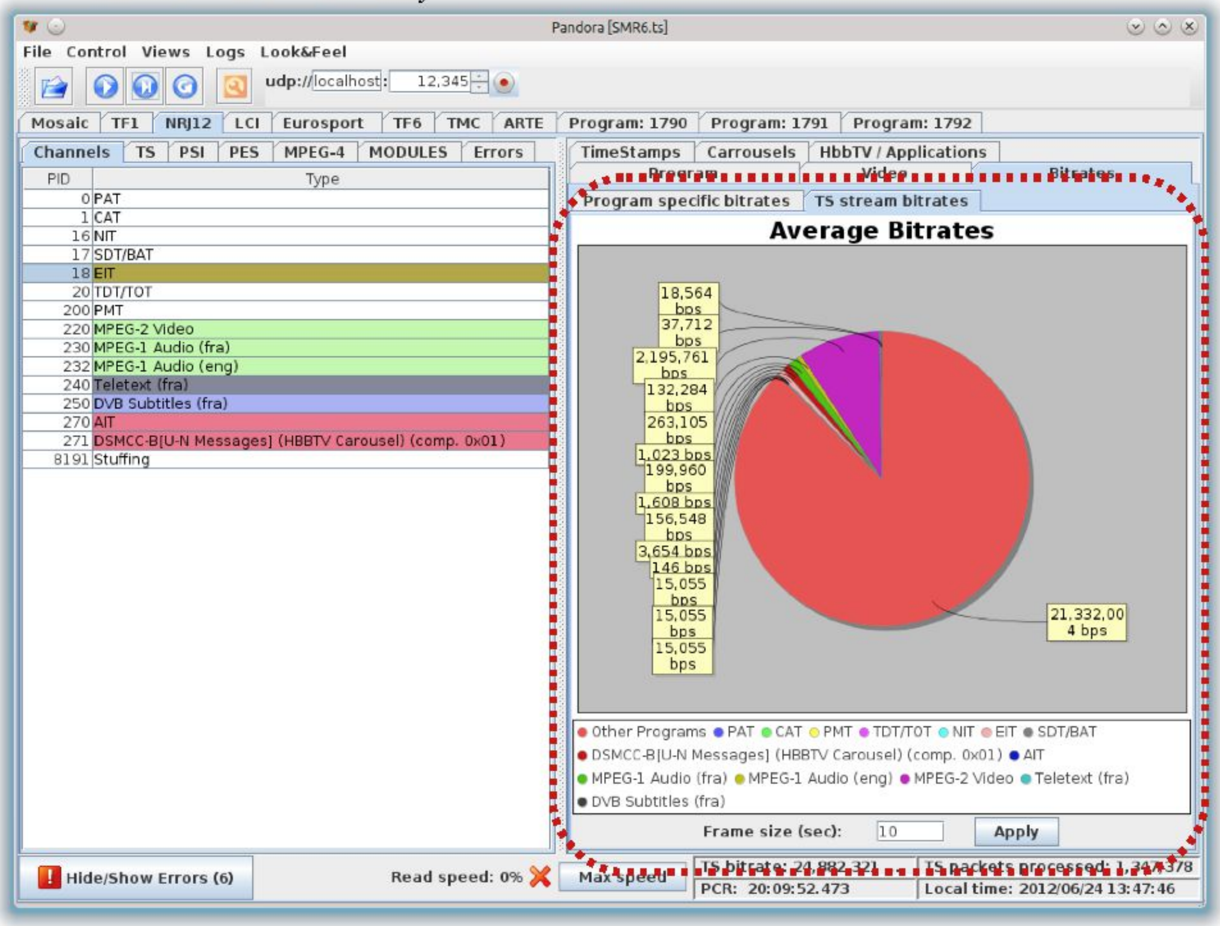
When the number of elementary streams is large, pie charts might become hard to read. Pandora offers charts filtering options, see Graphs filtering.

Illustration 16: Stream Bitrate analysis - program view



PID	Type
0	PAT
1	CAT
16	NIT
17	SDT/BAT
18	EIT
20	TDT/TOT
200	PMT
220	MPEG-2 Video
230	MPEG-1 Audio (fra)
232	MPEG-1 Audio (eng)
240	Teletext (fra)
250	DVB Subtitles (fra)
270	AIT
271	DSMCC-B[U-N Messages] (HBBTV Carousel) (comp. 0x01)
8191	Stuffing

Illustration 17: Stream Bitrate analysis - main view



4.2.7 Program clocks

View access : Select a channel in the main tab panel, then select the "Timestamps" tab in the right panel. If the "Timestamps" tab is not present, use the menu bar: Views> Timestamps.

The Pandora analyzer handles several kinds of clocks:

- Stream clocks (Illustration 18):
  - Program stream clock: if the program declares a clock stream (the stream that carries PCR timestamps), the whole Transport Stream bitrate can be computed within the scope of this program. A graph shows the successive transport bitrate values, providing a quick overview of transport bitrate variation over time. If the program does not declare a PCR holder, no transport bitrate information will be processed for this program.
  - Elementary streams clocks: for all timed elementary streams declared by the program (audio / video / subtitles / teletext, …), the last values of the carried PES timestamps are listed in a dedicated table. Each row shows the following description:
    - PID of the elementary stream.
    - Human-readable label for the stream.
    - Presentation TimeStamp (PTS) value: as read from the PES header. If no PTS value is declared for the PES packet, the current stream time (PCR) value is taken for the PTS value.
    - PTS delay value: the difference between the PTS value and the current stream time (PCR).
    - Decoding TimeStamp (DTS) value : as read from the PES header. If no DTS value is declared for the PES packet, the DTS value is taken from the PTS value (normative).
    - DTS delay value: the difference between the DTS value and the current stream time (PCR).

  If the program does not declare a PCR holder, no PTS/DTS delay values will be processed for the elementary streams.
- Main clocks (Illustration 19): The bottom-right area of the Pandora windows displays miscellaneous clock information:
  - The last computed Transport Stream bitrate value (within the program scope).
  - The last computed stream clock (PCR) value.
  - The current service time: as read from the Time and Date Table (TDT) if present, and adjusted to local time if a Time Offset Table (TOT) is present.

Illustration 18: Program clocks analysis

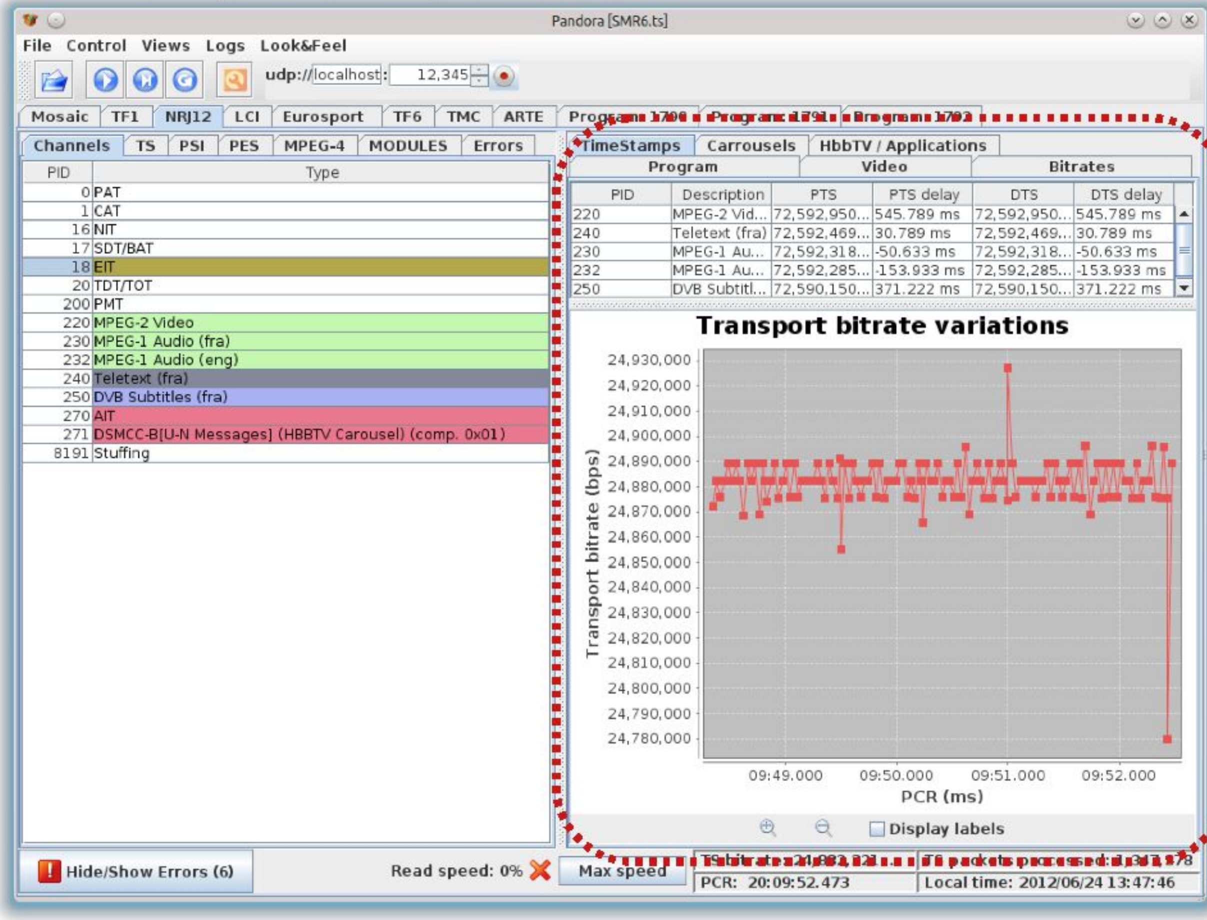




Illustration 19: Main clocks

4.2.8 Data repetition rate

View access : Select a channel in the main tab panel, then select the "Carousels" tab in the right panel. If the "Carousels" tab is not present, use the menu bar: Views> Carousels .

Data repetition rate view presents information of service data repeat cycles (aka "carousels") over time. The carousel values are computed this way:

- For PES data (audio/video/etc.), the carousel value stands for the elapsed stream type between two consecutive start TS packets (with the payload_unit_start_indicator set to 1).
- For PSI data (TS/DVB/DMB tables), the carousel value is computed for the entire table (possibly composed with several sections). This way, the carousel value gives the information about how often the associated service data table is repeated.

Repetition rate can be accessed in two modes:

- Last values mode (Illustration 20): The last carousel values for elementary streams associated with the program are gathered in a bar chart.
- Timeline mode (Illustration 21): Successive carousel values for each elementary stream are displayed in superimposed line graphs, allowing to track changes over time.

For easier charts view when there are a large number of elementary streams, Pandora offers filtering options, see Graphs filtering.

Illustration 20: Data repetition rate - instant view

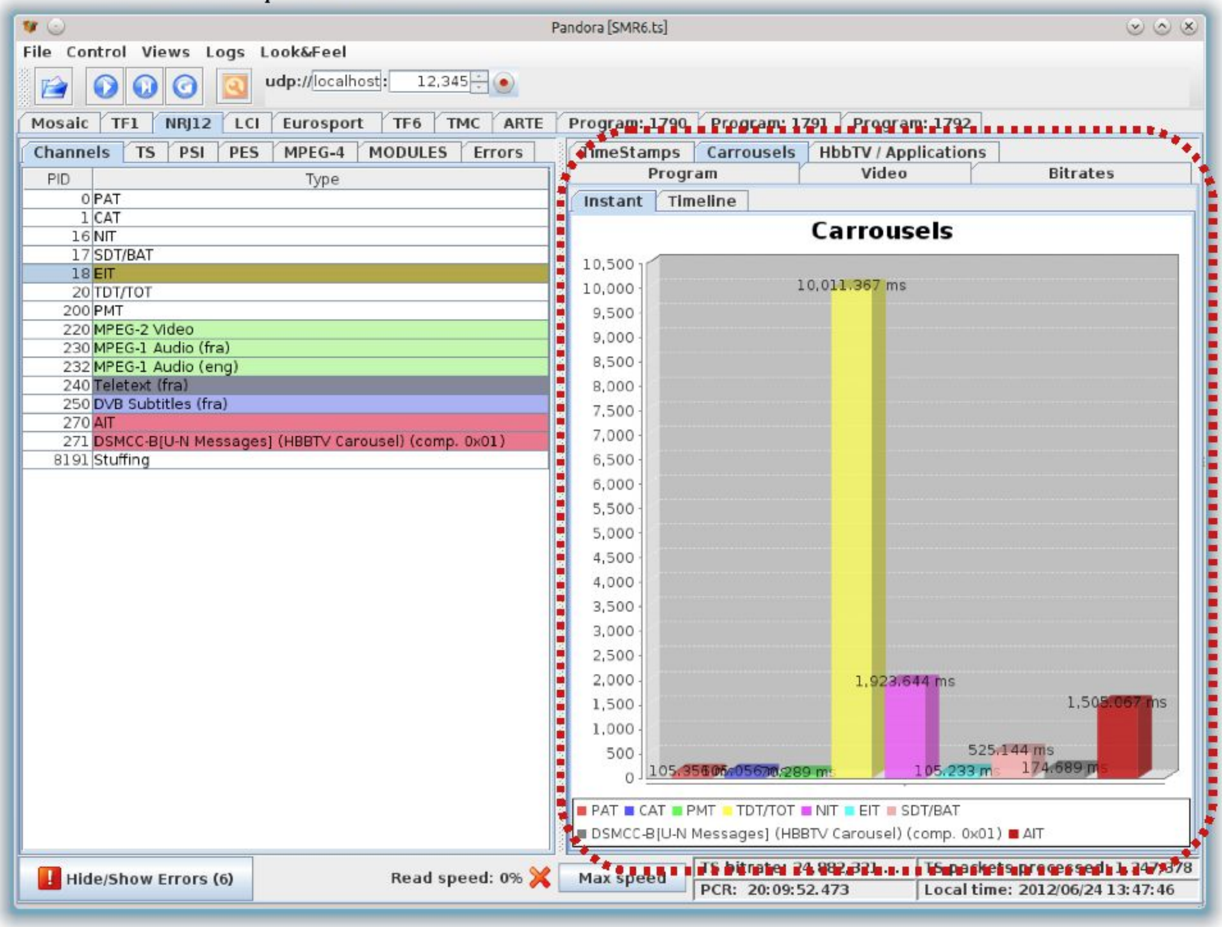
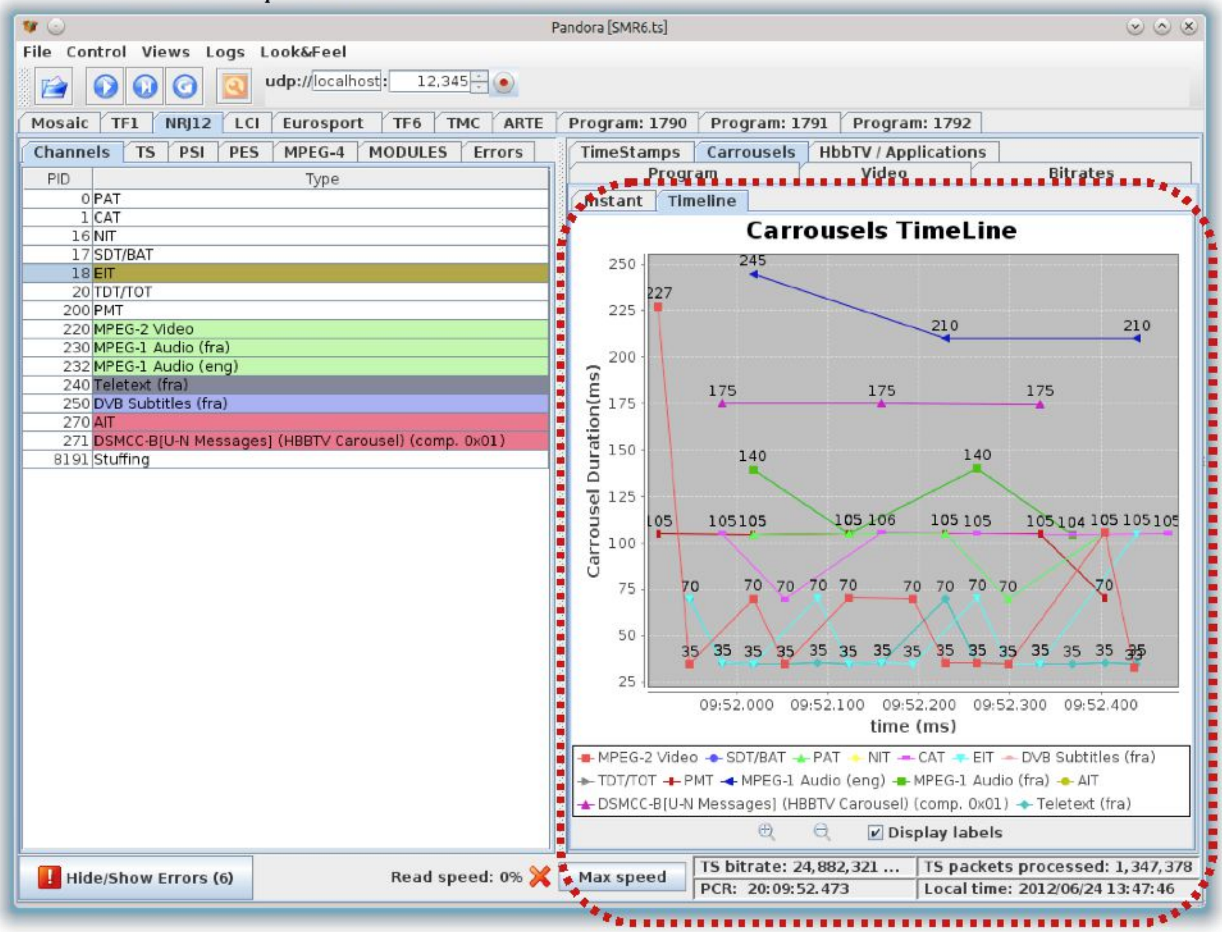


Illustration 21: Data repetition rate – timeline view



4.2.9 Data weight

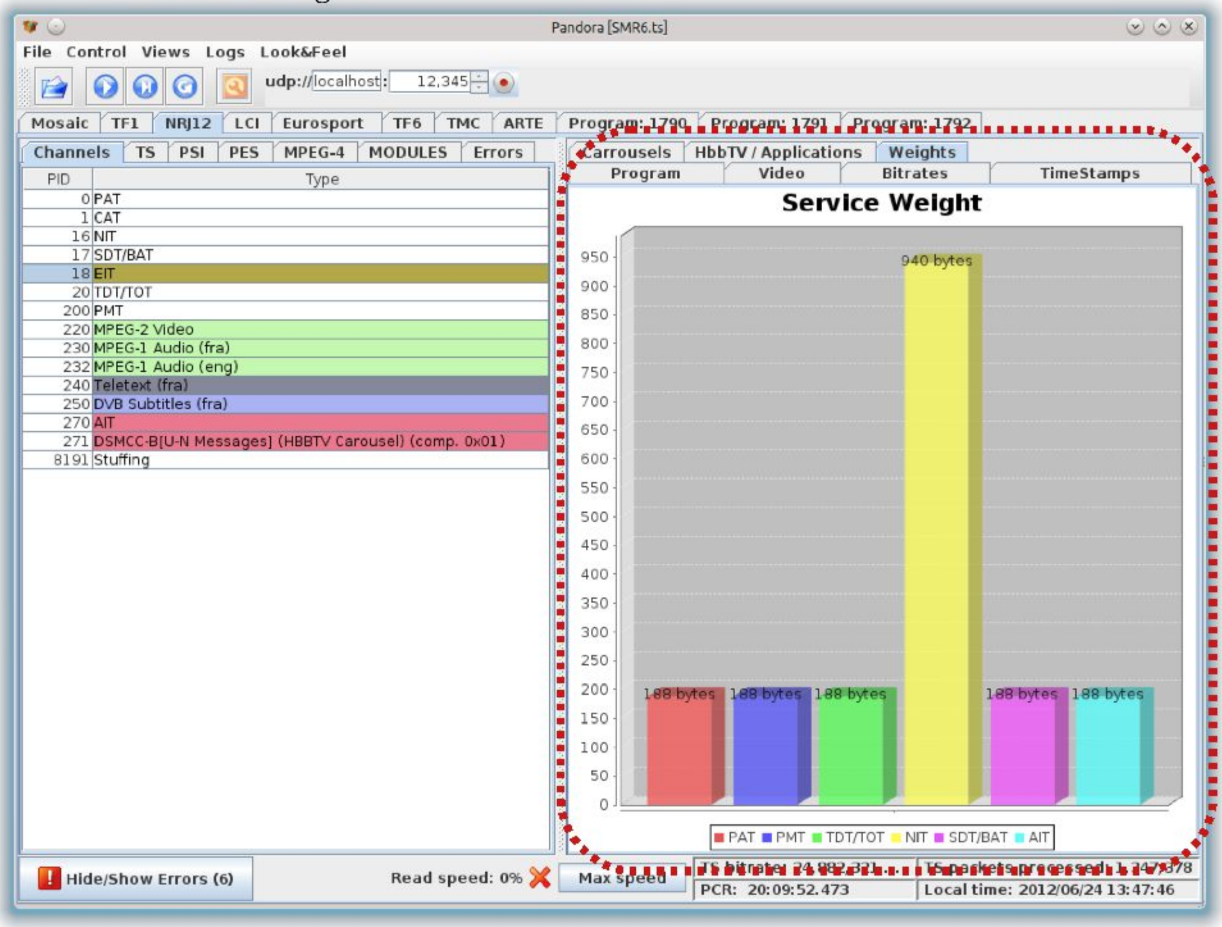
View access : Select a channel in the main tab panel, then select the "Weights" tab in the right panel. If the "Weights" tab is not present, use the menu bar: Views> Weights .

From Pandora's point of view, service data weight can be expressed in the following ways:

- For PES data (audio/video/etc.), the data weight stands for the weight (in bytes) of a data packet (e.g. an encapsulated audio chunk), including all successive encapsulation headers. Pandora also provides encapsulation overhead analysis, see Stuffing analysis.
- for PSI data (TS/DVB/DMB tables), the data weight stands for the weight (in bytes) of a whole table, including all successive encapsulation headers.

The service weight data is gathered in a bar chart view that displays the last computed weight value for all the elementary streams associated with the program (Illustration 22). For easier charts view when there are a large number of elementary streams, Pandora offers filtering options, see Graphs filtering.

Illustration 22: Service weights



4.2.10 HbbTV Applications Data

View access : Select a channel in the main tab panel, then select the "HbbTV/Applications" tab in the right panel. If the "HbbTV/Applications" tab is not present, use the menu bar: Views>HbbTV/Applications .

The Pandora Analyzer provides full support for HbbTV applications:

- Full decoding of the Application Information Table (AIT), including:
  - Application/Organization IDs.
  - Application priority, control code and entry point.
  - Broadband signaling: base URL and domain boundaries.
  - Overview of the entry point page (Illustration 23). When a remote link is provided in broadband mode, the page contents are automatically loaded into a dedicated text area. Moreover, the broadband link can be opened in a web browser (some plugins can emulate HbbTV).
- HbbTV Object Carousels:
  - Full decoding of the HbbTV stack (DSMCC Type B > BIOP > files).
  - Full restitution of the broadcast file system (Illustration 24):
    - Tree view for files browsing.
    - Any decoded file can be viewed and saved.
    - Ability to capture a whole transaction and save the captured file system.
    - Ability to play the HbbTV carousel contents (if it holds the application entry point) in a web browser.
  - Timeline view (Illustration 25) of the DSMCC modules for the Object Carousel (including signaling through DSI/DII messages).
  - Table view of each module composition (Illustration 24). This table shows how the broadcasted files and Stream Events were split into DSMCC modules.
- Stream Events:
  - Decoding of Stream Events objects declaration in an Object Carousel.
  - Decoding of Stream Events triggers (Stream Event Descriptors) on DSMCC Type C streams (Illustration 26).
- Support for multiple applications within a program.

Illustration 23: HbbTV analysis - AIT decoding

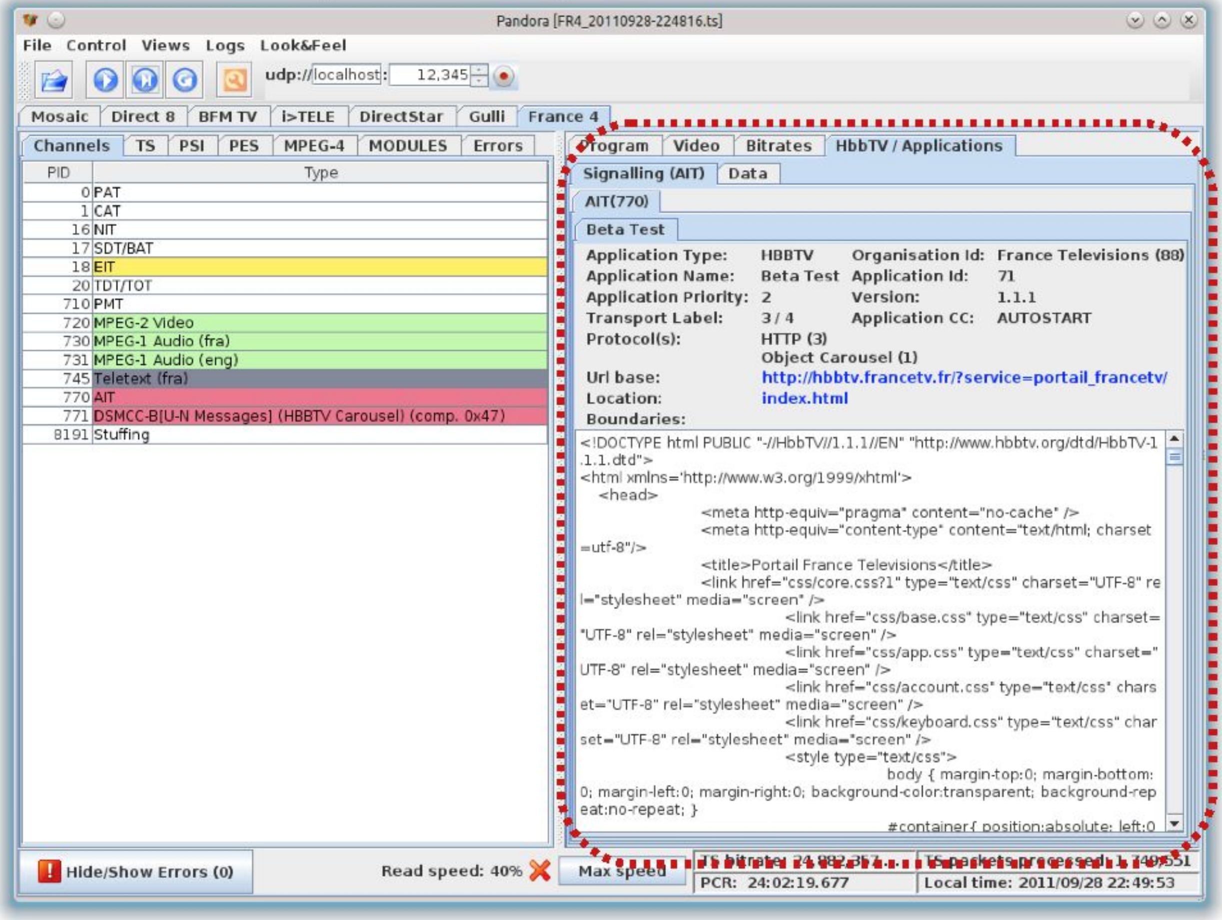


Illustration 24: HbbTV analysis - File System view

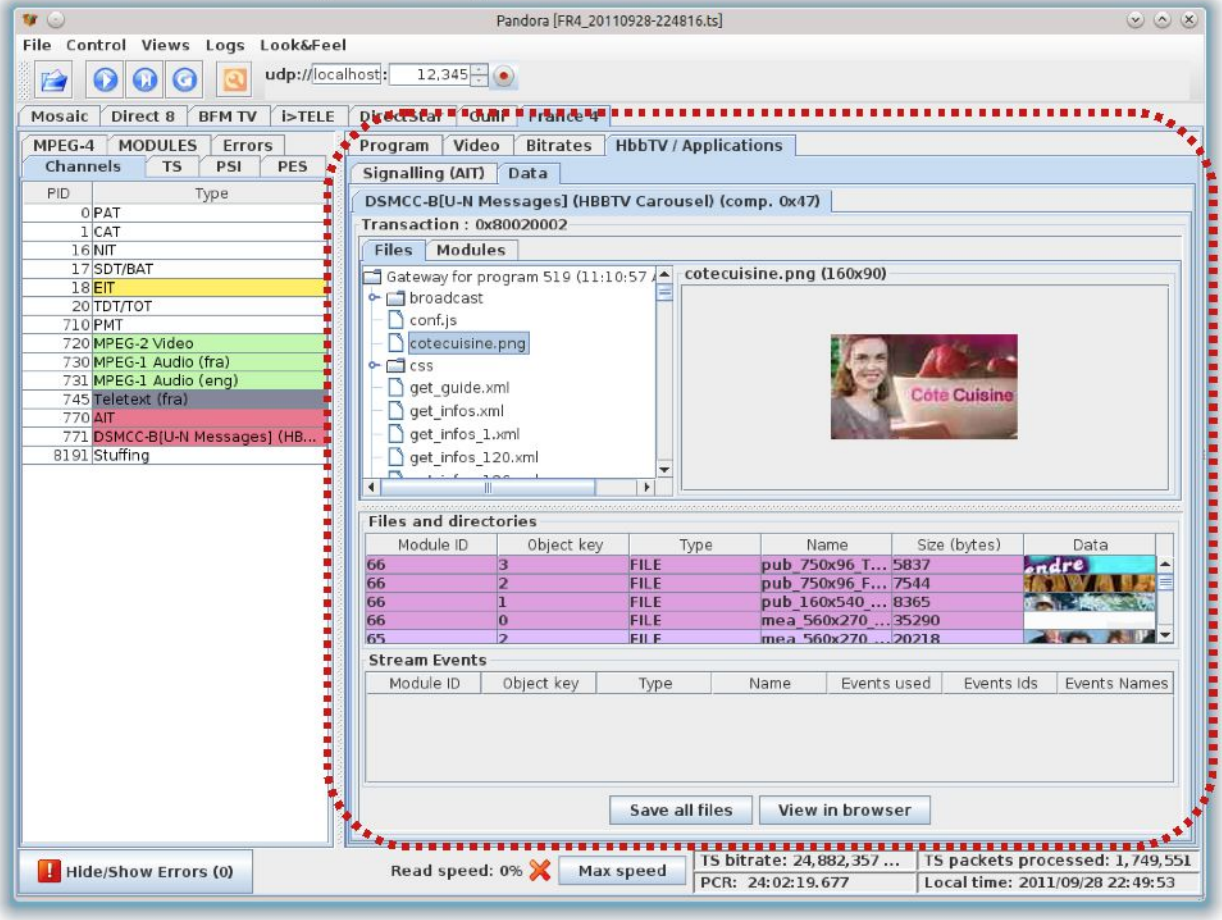


Illustration 25: HbbTV analysis - DSMCC modules timeline

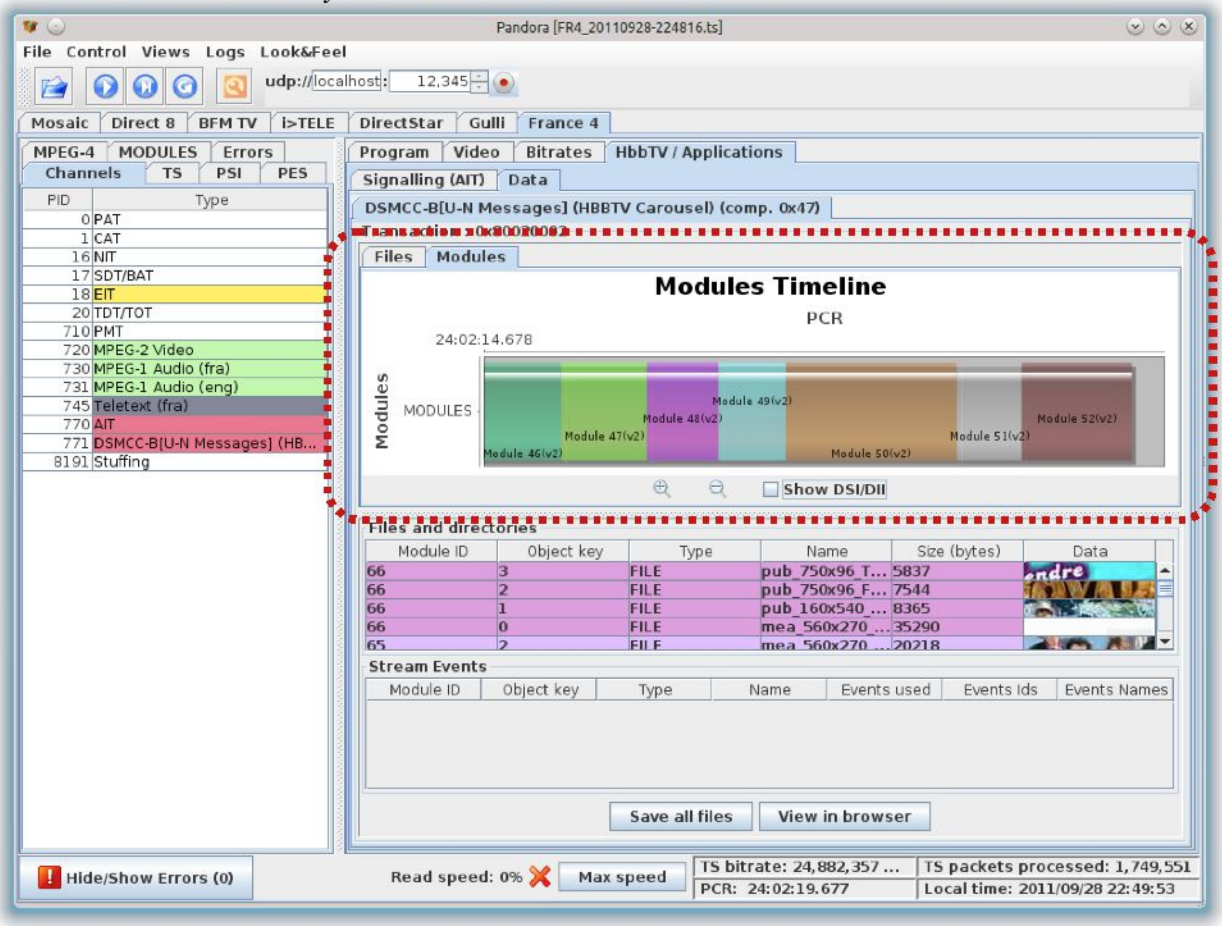
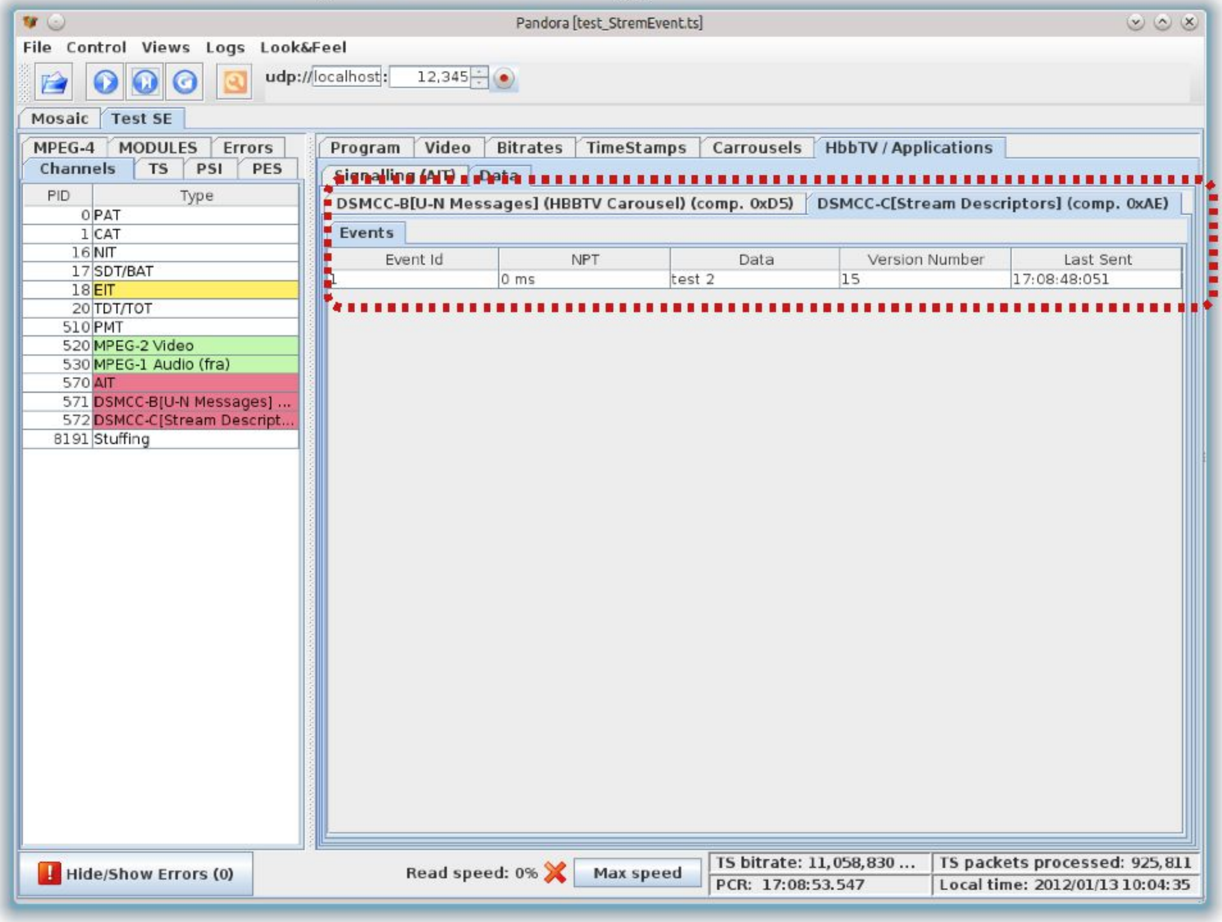


Illustration 26: HbbTV analysis - Stream Events triggers



5 Advanced Features

Pandora provides other useful analysis and decoding features, described in this section. Notice that every new developed feature is integrated to the trunk version of Pandora, therefore a simple software update (see Update Pandora version) provides access to these features.

5.1 Graphs filtering

<u>Configuration panel access</u> : Click on the "tools" icon to open the advanced configuration panel, or use the menu bar: File>Configure...

The advanced configuration panel provides a "Chart control" section that allow to apply filtering on the analysis graphs. A bunch of checkboxes, ordered by decoding layer (TS / PSI / PES / …) trigger stream analysis showing/hiding. This way, chart views can be cleared up to ease results acknowledgment. Notice that filtering configuration is stored in Pandora user preferences and is automatically restored at Pandora re-opening. Don't forget to check filtering configuration first if a program stream seems to be missing in some analysis result.

The example below (Illustration 27, Illustration 28) shows filtering effect on a bitrate chart:

- When no filter is applied, the video bitrate large value shadows the other elementary streams results.
- When applying a filter to disable PES data, the remaining analysis information becomes more clear.

Illustration 27: Graphs filtering - no filter

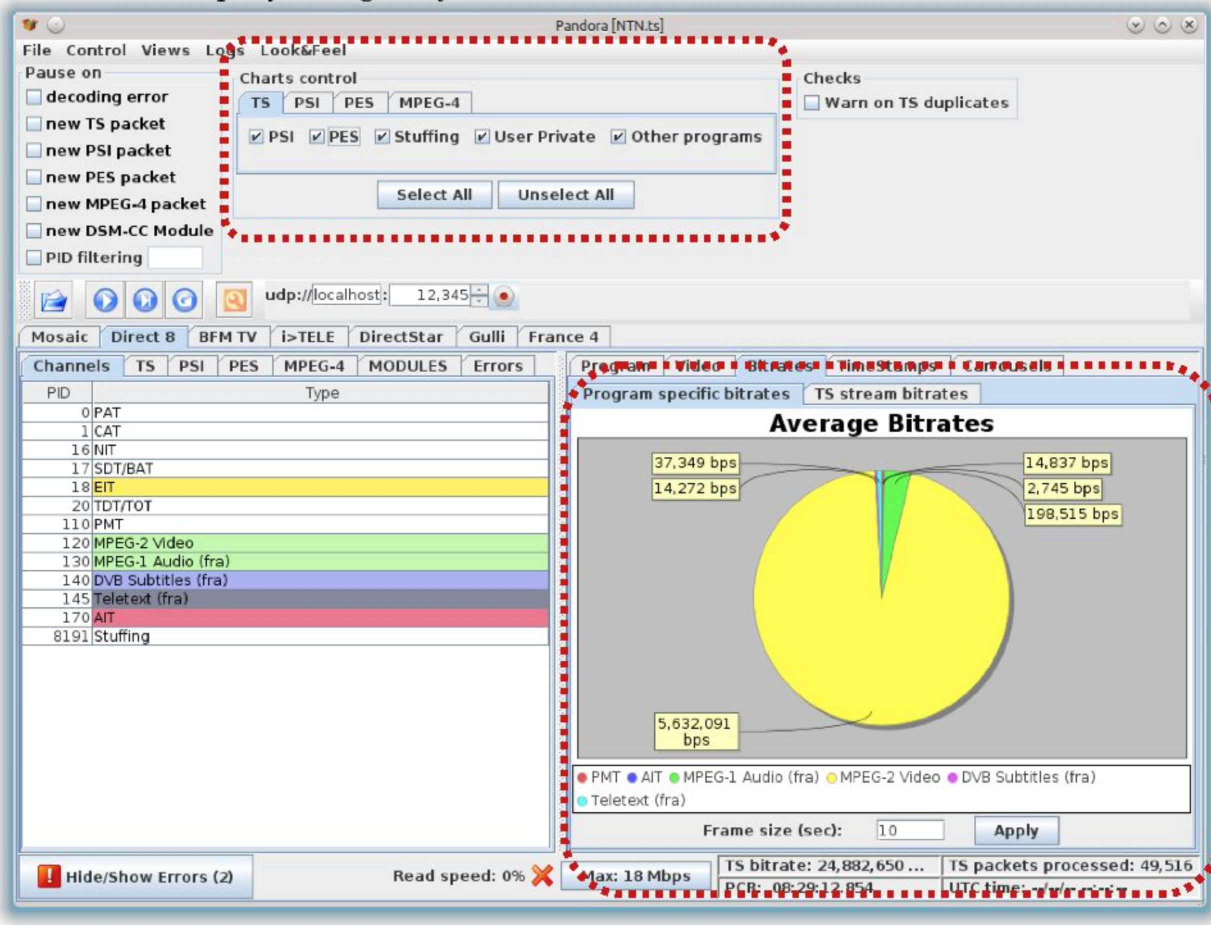
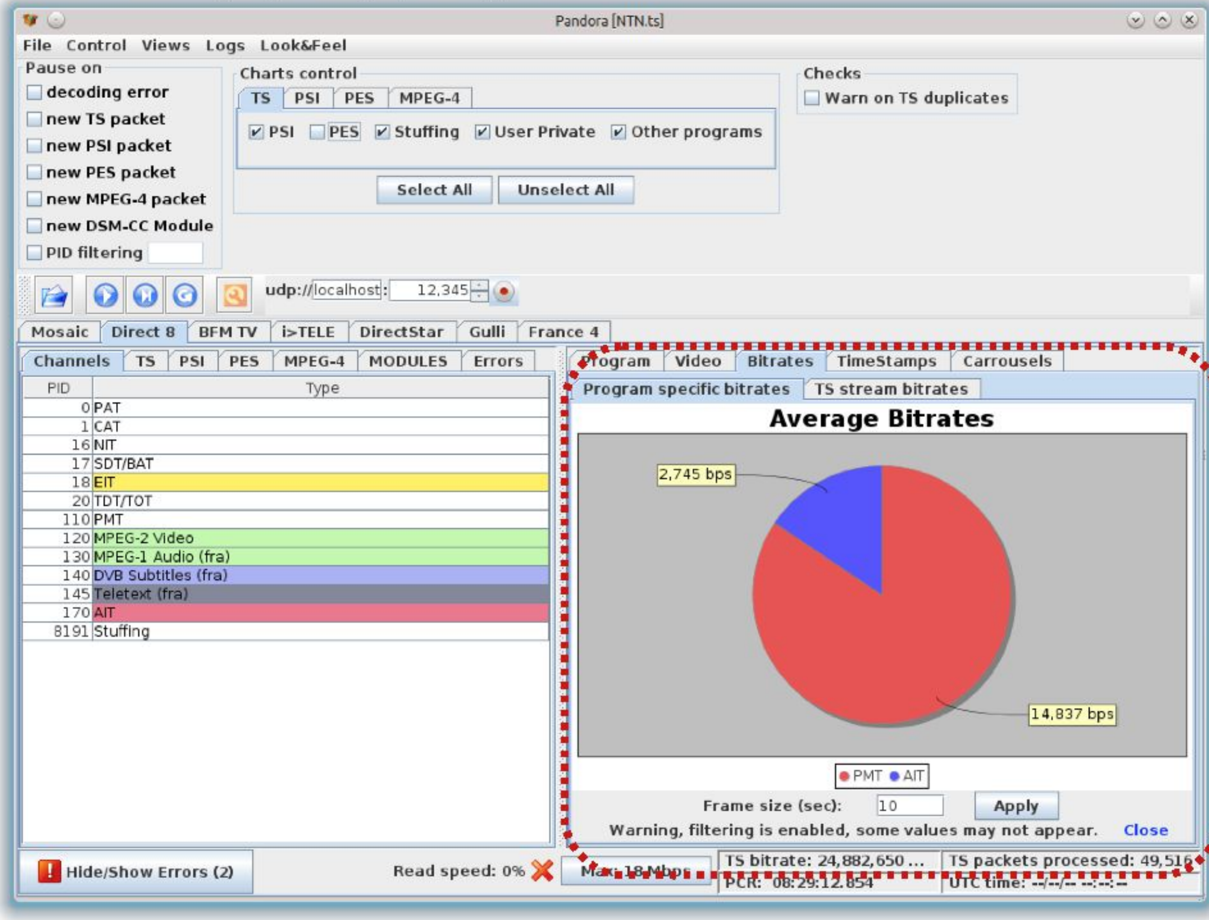


Illustration 28: Graphs filtering - filter applied



5.2 Pause triggering on decoding events

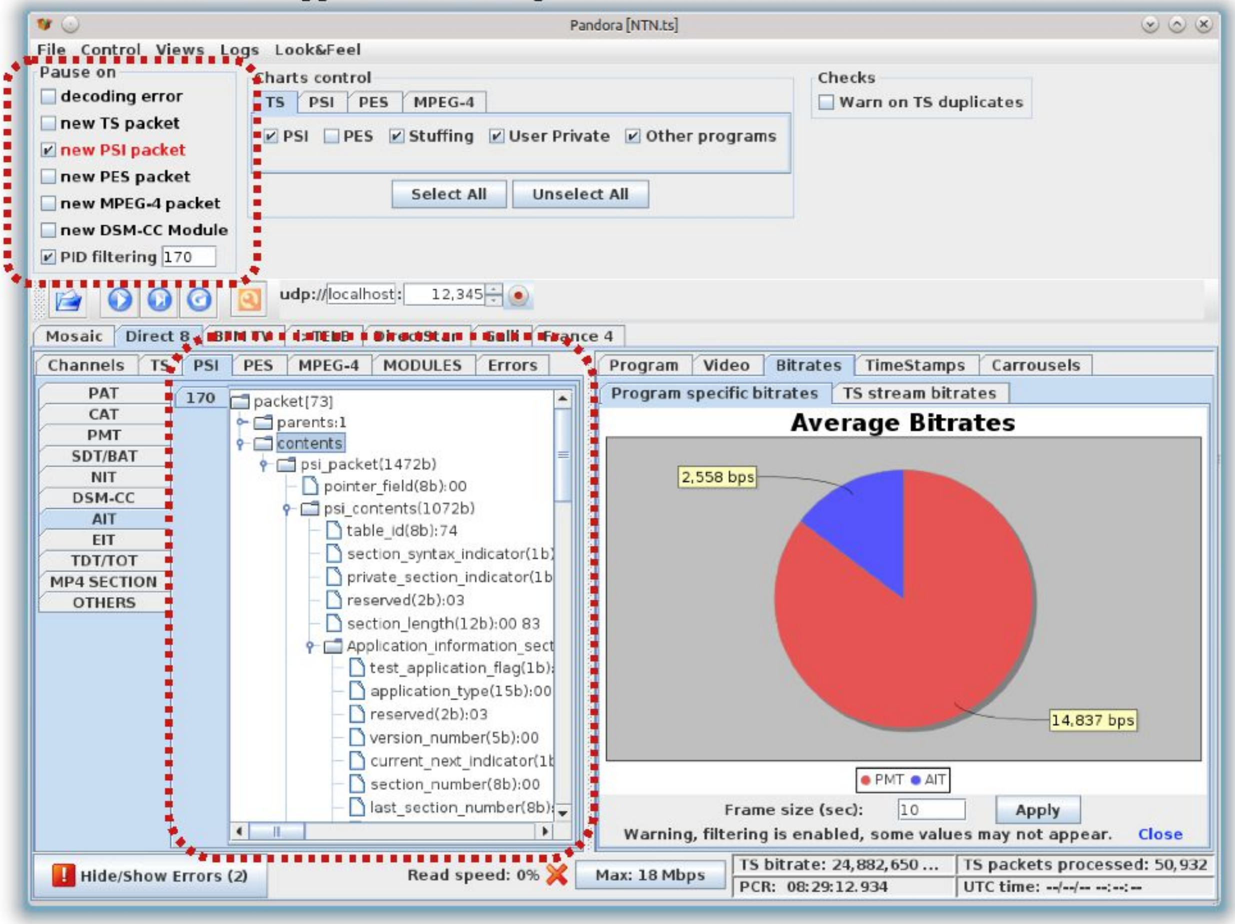
Configuration panel access : Click on the "tools" icon to open the advanced configuration panel, or use the menu bar: File>Configure...

For precise debugging or validation of a given TS stream, Pandora offers a configuration interface (Illustration 29) to program automatic pause on some decoding events:

- When a decoding error occurs.
- When a new packet was found in a given decoding layer (TS / PSI / PES / DSMCC / etc.). A target PID can also be provided. If set, a programmed event will trigger a pause only if the corresponding packet PID matches the provided PID.

When any of the programmed events is triggered, the decoding process stops instantly. When the decoding processed is stopped for a programmed event, the triggering event is highlighted and the appropriate tree view (see Elementary streams packets) is shown.

Illustration 29: Pause trigger on a decoding event



5.3 Dumping options

View access : For raw UDP streaming, configuration is done with the UDP configuration panel (Illustration 30) under the menu bar. For advanced capture option, select a channel in the main tab panel, then select the "Program Capture" tab in the right panel. If the "Program Capture" tab is not present, use the menu bar: Views> Program Capture .

Pandora allows to redirect the input TS stream to an UDP or file destination in two available modes:

- Raw UDP streaming mode (Illustration 30): The input TS stream is redirected to a unicast/multicast UDP destination.
- Program capture (Illustration 31): A more sophisticated interface allows to extract a single program from the input stream:
  - Stuffing can be preserved or filtered.
  - The capture can be done for UDP or local file destination.
  - All programs can be captured independently and simultaneously.

  Notice that when a single program is extracted from the input stream, a new Program Association Table is generated to reject all other programs declaration.

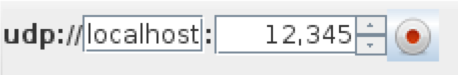
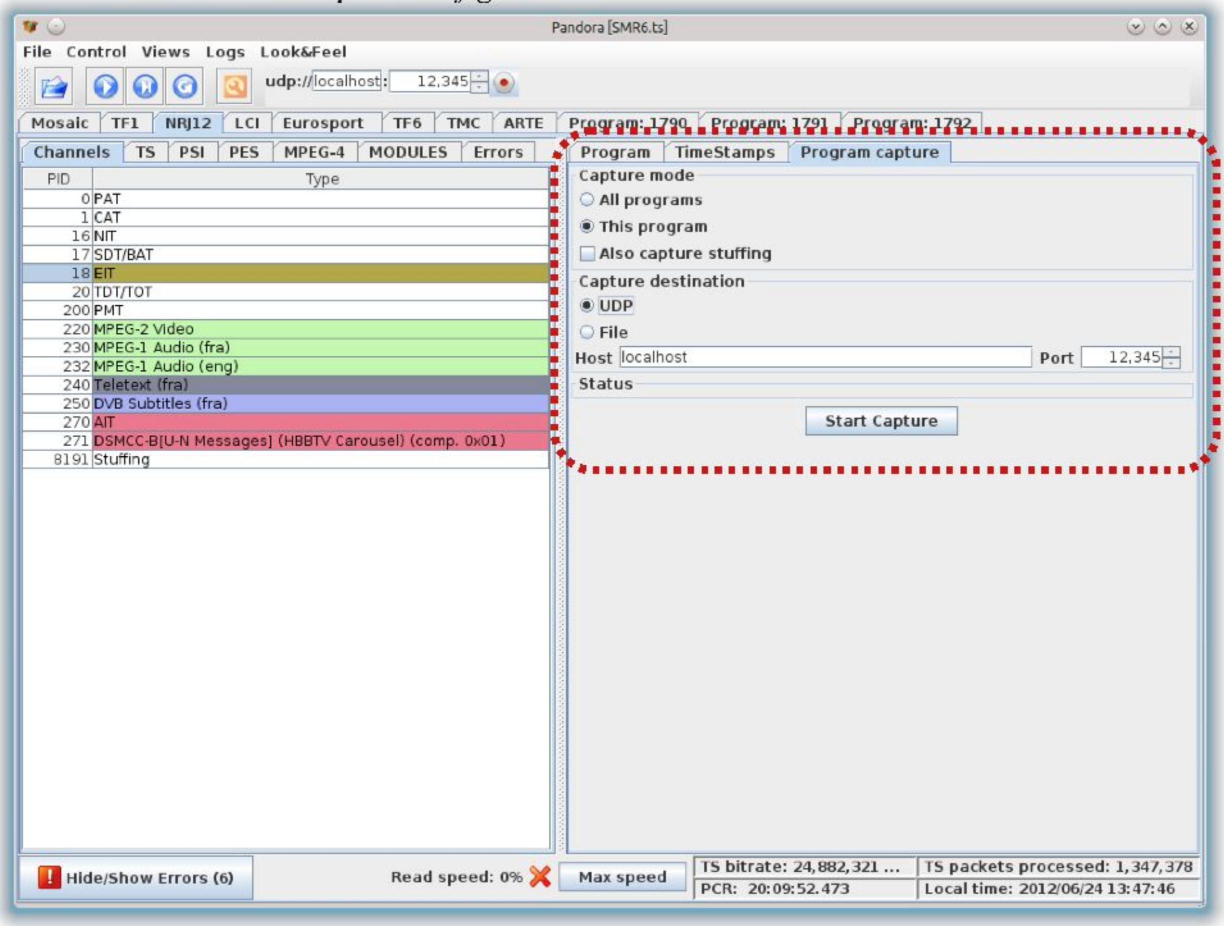


Illustration 30: Configure TS streaming to UDP

Illustration 31: TS Stream capture configuration



5.4 Decoding speed control

<u>Decoding Speed Configuration access</u> : Click on the "speed" Max speed button at the bottom of the Pandora window to open the decoding speed configuration panel, or use the menu bar: Control>Read speed configuration...

When performing analysis on static TS files, the decoding process runs with no speed limit by default. The instant decoding speed is displayed at the bottom of the Pandora window (<u>Illustration 32</u>), along with a small icon (or) that states whether Pandora is decoding the stream faster (or equals) to the transport stream bitrate, or not.

Depending on the machine characteristics, the decoding speed might be too high for an easy inspection of the stream contents. Pandora allows to limit (or not) the maximum decoding speed through a configuration dialog (<u>Illustration 33</u>). Notice that this option assigns an upper speed limit to the decoding head, but this limit might never be reached.

Illustration 32: Pandora decoding speed

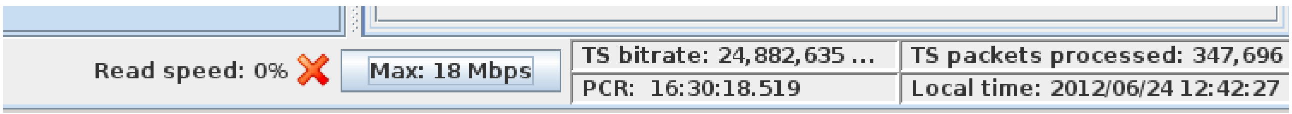
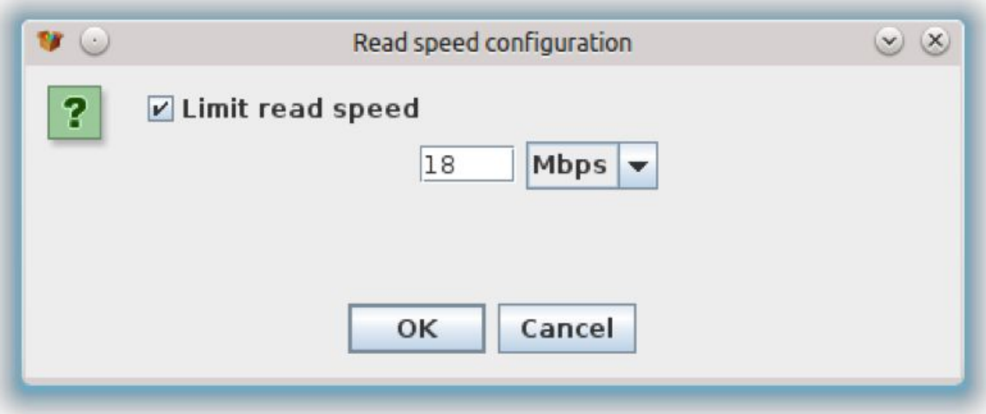


Illustration 33: Configure decoding speed - dialog

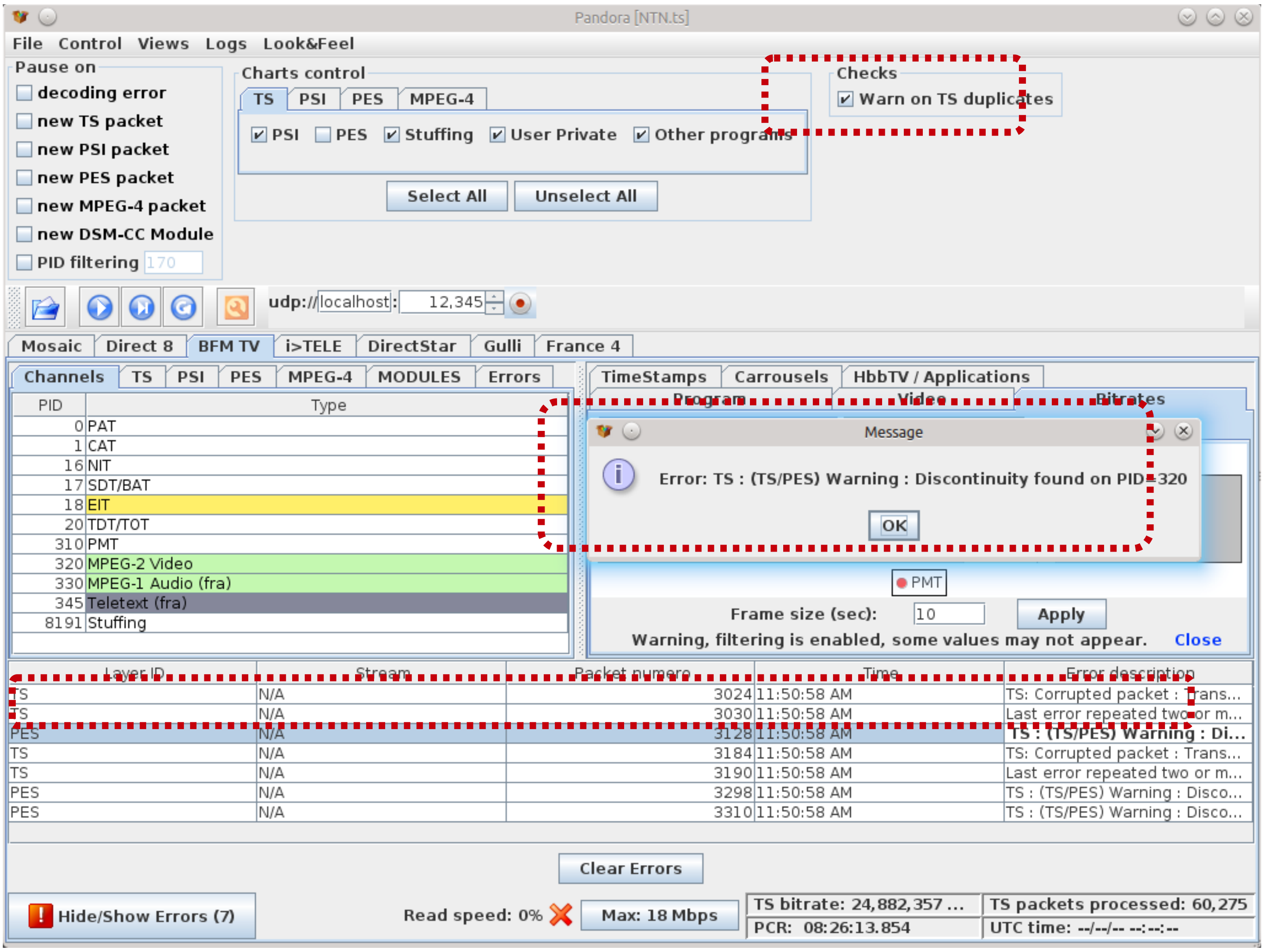


5.5 Packets Sequence check

<u>Configuration panel access</u> : Click on the "tools"  *icon to open the advanced configuration panel, or use the menu bar: File>Configure...*

Pandora can check the TS continuity counters to track packets duplicates and possible data loss. If the "Warn on TS duplicates" option is active (<u>Illustration 34</u>), an error item will be logged in the errors table (see <u>Decoding Errors</u>) when a discontinuity or a packet duplicate is found. By default, this option is not active.

Illustration 34: TS packets sequence check



5.6 Decoding Errors

<u>Errors panel access</u> : Click on the "Hide/Show Errors" 

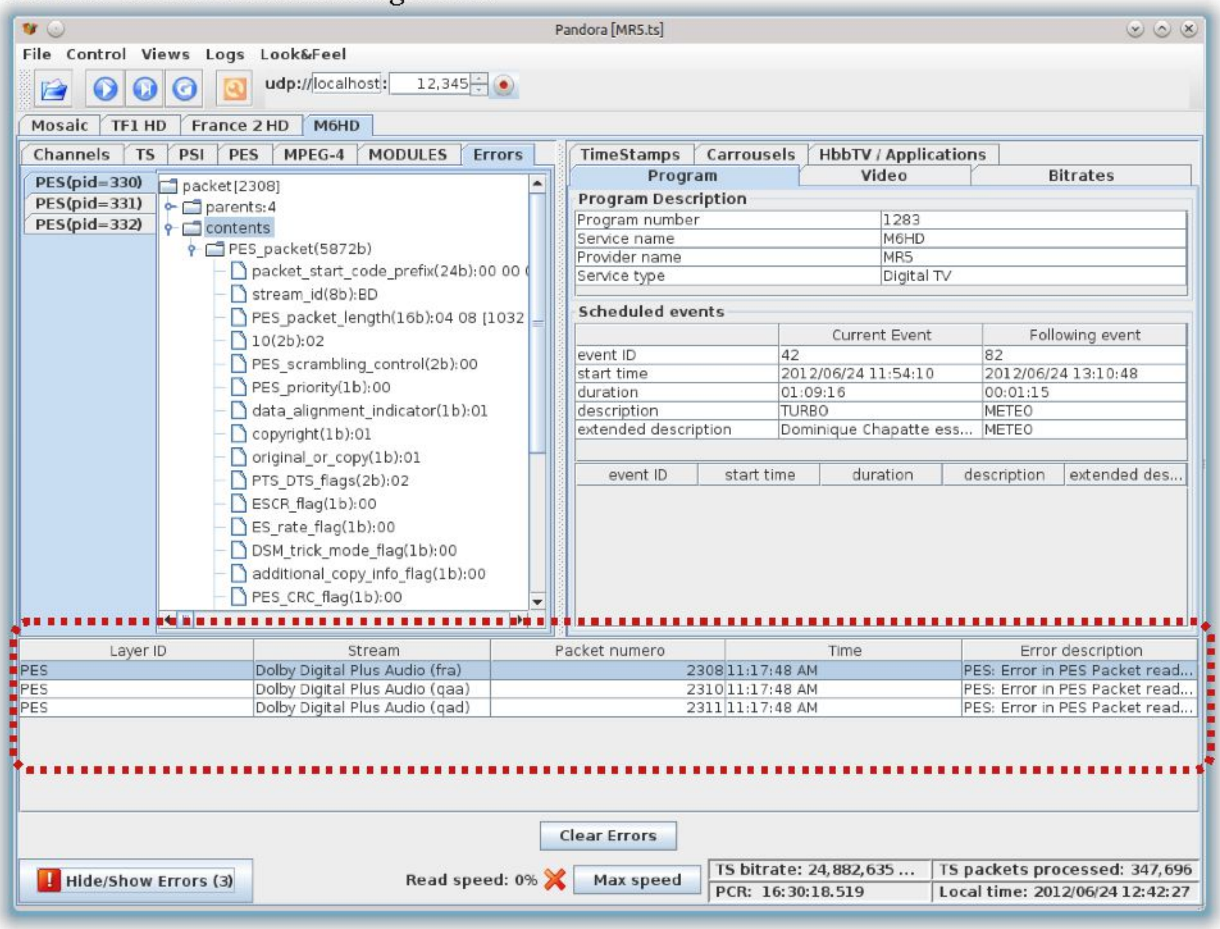
button at the bottom-left of the Pandora window to expand/collapse the errors table.

When an error occurs during the decoding process, an error item is generated by Pandora and stored in a dedicated error table (<u>Illustration 35</u>). An error item has the following format:

- Layer ID: The decoding layer for the errored packet (TS, PSI, PES, etc.).
- Stream ID: The human-readable label associated with the elementary stream that holds the errored packet.
- Packet number: The number of the packet, incrementally set by the layer decoder for the errored packet.
- Time: The system time when the error occurred.
- Description error: A description for the error.

Moreover, the errored packet is also stored in an "ERROR" tab in the <u>elementary stream packets view</u>, to allow inspection of the errored or corrupted data. Notice that Pandora allows to trigger automatic pause on decoding errors, see <u>Pause triggering on decoding events</u>.

Illustration 35: Pandora decoding errors



5.7 Stuffing analysis

View access : Select a channel in the main tab panel, then select the "Stuffing" tab in the right panel. If the "Stuffing" tab is not present, use the menu bar: Views> Stuffing .

The amount of stuffing in an input TS stream is computed in two modes:

- Main stuffing bitrates mode (Illustration 36): four kind of stuffing analysis are performed on the stream:
  - Null packets stuffing bitrate: corresponds to the bitrate for the 0x1FFF PID (TS null packets).
  - PSI packets stuffing bitrate: corresponds to the accumulated bitrate of sections stuffing.
  - PES packets stuffing bitrate: corresponds to the acumulated TS adaptation field stuffing for PES elementary streams.
  - Global stuffing: the sum of the previous stuffing bitrates.
- Transport overhead bitrates mode (Illustration 37): for PES elementary streams (audio, video, subtitles, etc.), Pandora displays a comparison between:
  - The neat bitrate of the elementary stream: considering only PES payload data bytes.
  - The overhead bitrate: considering all the encapsulation headers for the payload data.

  This view can provide an overview of the source PES encoder performance to minimize the transport headers.

Illustration 36: Stuffing Analysis - overview

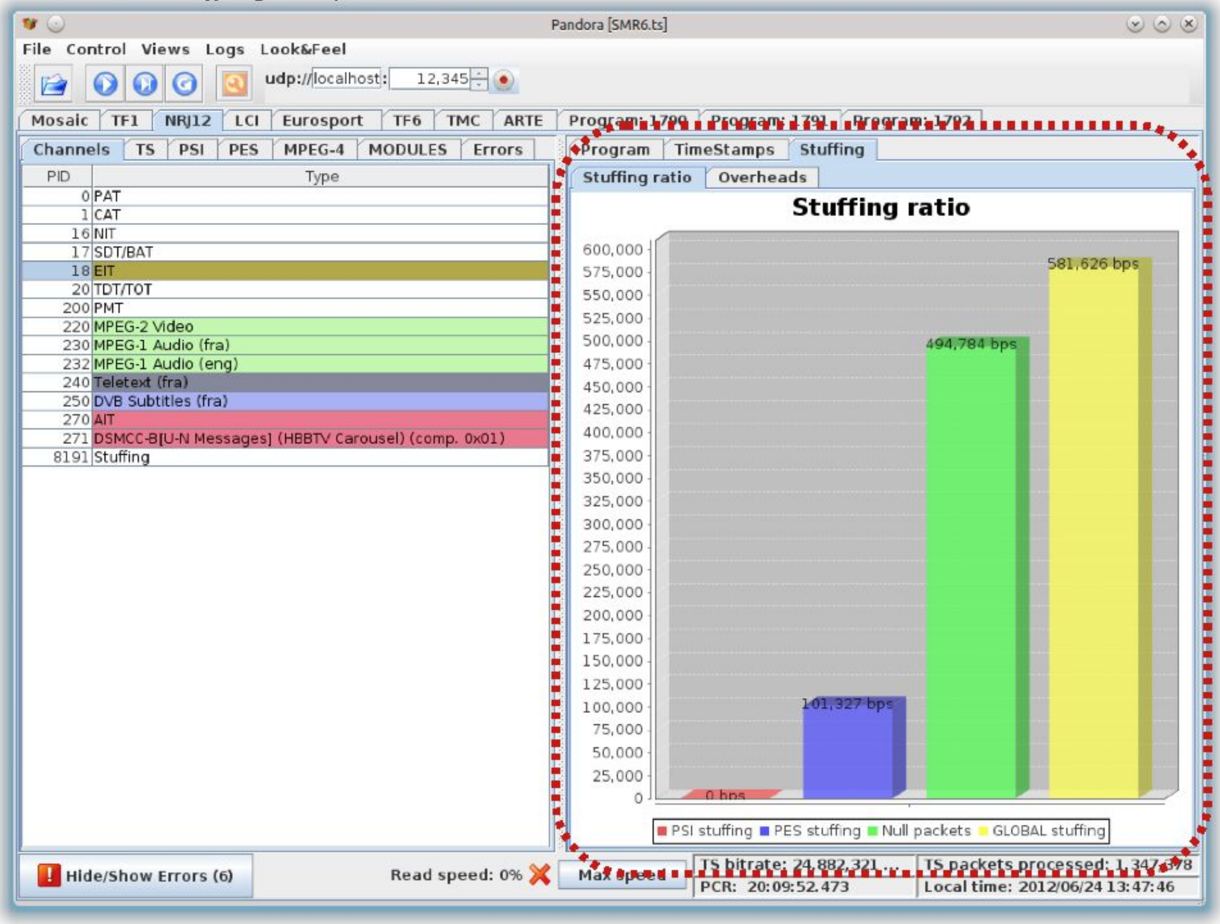
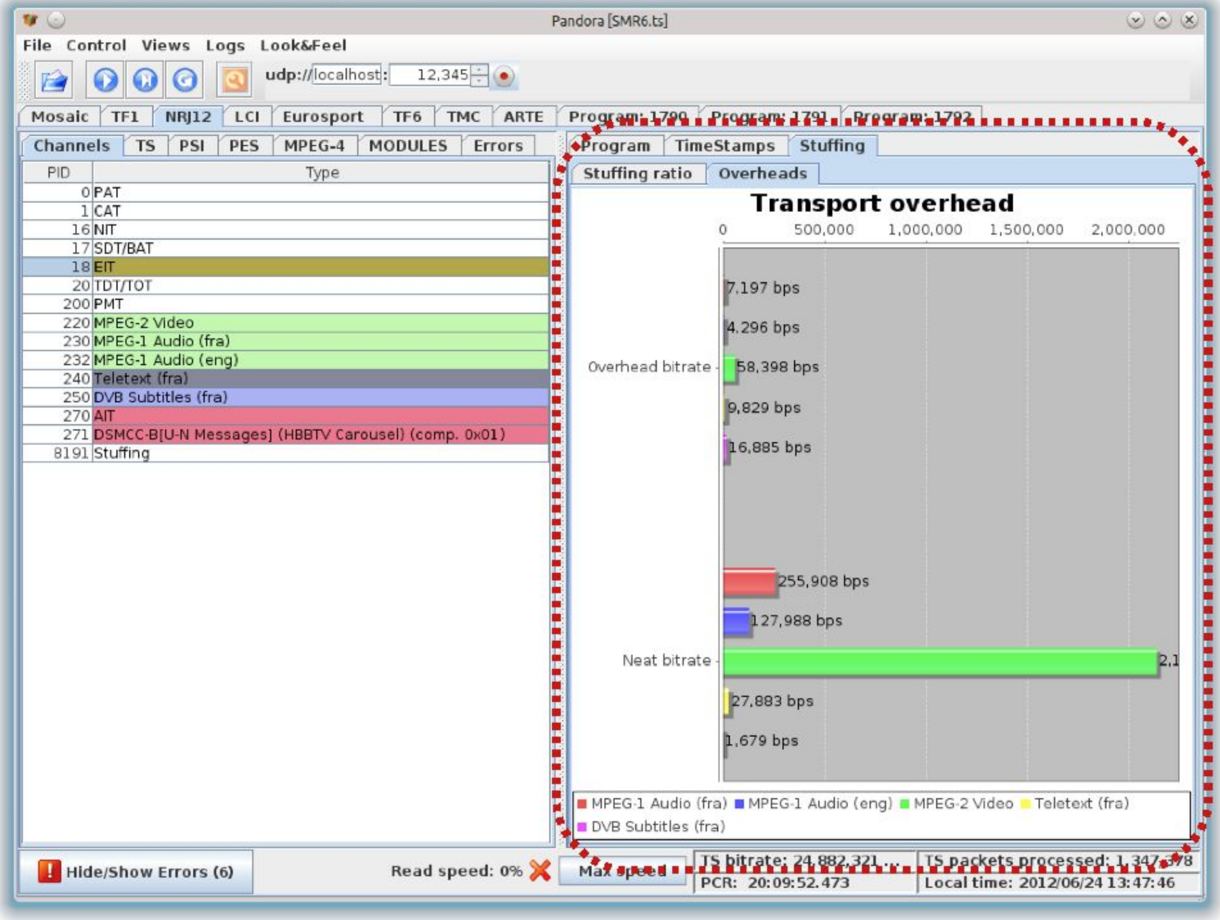


Illustration 37: Stuffing Analysis - overheads



5.8 DMB analysis

View access : Select a channel in the main tab panel, then select the "DMB Contents" tab in the right panel. If the "DMB Contents" tab is not present, use the menu bar: Views> DMB Contents .

The Pandora Analyzer provides full decoding of DMB contents:

- Full decoding of MPEG-4 InitialObjectDescriptor within the Program Map Table (PMT).
- Advanced decoding of MPEG-4 part 1 and MPEG-4 par 11 framework:
  - Decoding of MPEG4-SL layer.
  - Full support for Object Descriptor specification.
  - Advanced decoding of BIFS scenes (profiles 1 to 10).
  - XMT-A rendering of IOD/OD/Scenes contents (Illustration 38).
  - Rendering of MPEG4-SL encapsulated images (Illustration 39).
  - Rendering of MPEG4-SL encapsulated video stream.

Illustration 38: DMB decoding - BIFS scenes

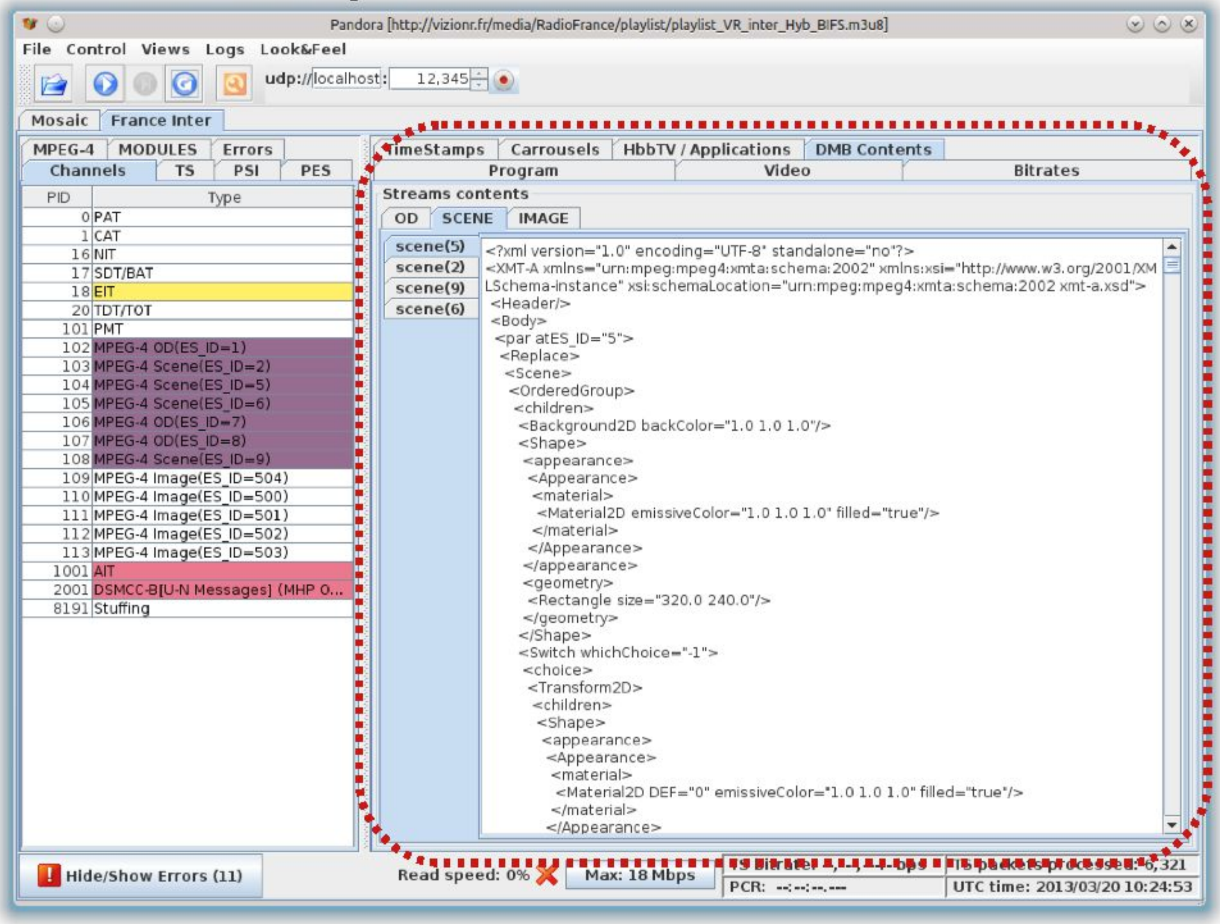
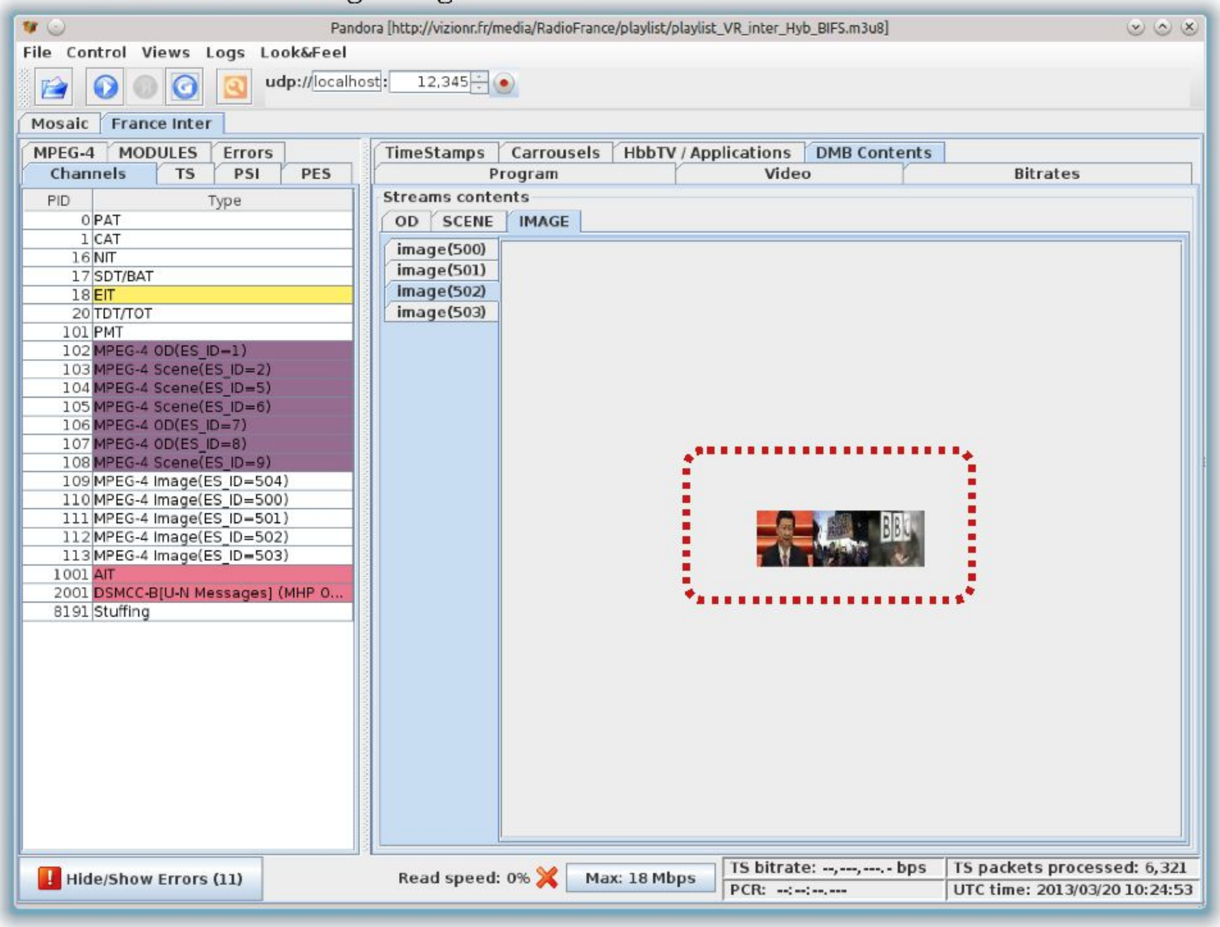


Illustration 39: DMB decoding - images



6 Update Pandora version

Pandora update access : via the menu bar: Look&Feel> Pandora Updates.

Don't forget to check for new Pandora releases as new features are frequently added!

If the running version is not the latest one, Pandora will suggest to download it (Illustration 40).

Illustration 40: Pandora version update dialog



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